PB85-175917

Assessment of Fluidized-Bed Combustion Solid Wastes for Land Disposal. Volume 6 Appendix H

Radian Corp., Austin, TX

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

Feb 85

U.S. Department of Commerce
National Technical Information Service
NTIS

PB85-175917

EPA/600/7-85/007f
February 1985

ASSESSMENT OF FLUIDIZED-BED COMBUSTION SOLID WASTES FOR LAND DISPOSAL

Volume 6. Appendix H

By:
H. J. Williamson, D. L. Heinrich, and T. W. Grimshaw

Radian Corporation
P.O. Box 9948, Austin, Texas 78766

EPA Project Officer: John Milliken

EPA Contract No. 68-02-3103

Air and Energy Engineering Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, North Carolina 27711

AIR AND ENERGY ENGINEERING RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA/600/7-85/007f	2.	3. RECIPIENT'S ACCESSION NO. PB85 175917/AS
4. TITLE AND SUBTITLE Assessment of Fluidized-bed Combustion Solid Wastes for Land Disposal, Volume 6. Appendix H		5. REPORT DATE February 1985
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) H. J. Williamson, D. L. Heinrich, and T. W. Grimshaw		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Radian Corporation P. O. Box 9948 Austin, Texas 78766		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-02-3103
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Air and Energy Engineering Research Laboratory Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Final; 6/80 - 6/84
		14. SPONSORING AGENCY CODE EPA/600/13

15. SUPPLEMENTARY NOTES AEERL project officer John O. Milliken is no longer with the Laboratory; for assistance contact Michael A. Maxwell, Mail Drop 61, 919/541-3091.

16. ABSTRACT The report, including 10 appendices, gives results of: (1) an analysis of representative samples of fluidized-bed combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field leaching results, and (5) assessment of the compatibility of commonly used landfill liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue gas desulfurization equipment to meet air quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field Group
Pollution Waste Disposal Combustion Fluidized Bed Processing Coal Assessments Desulfurization Earth Fills Linings Sorbents	Pollution Control Stationary Sources	13B 14B 07A, 07D 21B 13C 11G 13H 21D

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release to Public	Unclassified	124
	20. SECURITY CLASS (This page) Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Abstract

The report, including 10 appendices, gives results of: (1) an analysis of representative samples of fluidized-bed combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field leaching results, and (5) assessment of the compatibility of commonly used landfill liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue gas desulfurization equipment to meet air quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

APPENDICES

		Page
	Volume 2.	
A.	Sources of FBC Waste and Disposal Media, Detailed Hydrologic Analysis, and Chemical Analytical Procedures	A-1
B.	FBC Solid Waste and Disposal Media Physical Properties	B-1
C.	Solids Composition of FBC Solid Waste and Disposal Media.....	C-1
	Volume 3.	
D.	Laboratory Leaching and Attenuation Behavior of FBC Wastes	D-1
E.	Behavior of FBC Wastes Under Field Conditions	E-1
	Volume 4.	
F.	Compatibility of Landfill Liner Materials with FBC Waste Leachate	F-1
	Volume 5.	
G.	Statistical Prediction of Field Leaching and Attenuation Behavior Based on Observed Laboratory Results	G-1
	Volume 6.	
H.	Quality Assurance and Control	H-1
	Volume 7.	
I.	Interpretation of Chemical Trends and Comparison of Leachate Composition with Water Quality Standards and Criteria	I-1
	Volume 8.	
J.	Data List for Leachate Analyses.....	J-1

Appendix H

QUALITY ASSURANCE AND CONTROL

By:

H.J. Williamson, D.L. Heinrich, and T.W. Grimshaw

NOTE: In some cases, lengthy tables in this appendix are removed from the text and included as attachments to minimize interruption of the flow of the text.

Table of Contents

		Page
H.1	Overview	H-1
H.2	Laboratory Quality Assurance and Control Procedures	H-3
	H.2.1 QA/QC Procedures for the Batch Equilibration Studies	H-3
	H.2.2 QA/QC Procedures for Chemical Analysis	H-4
	H.2.2.1 Calibration of Instruments	H-4
	H.2.2.2 Spiked Samples	H-10
	H.2.2.3 Standard Samples	H-12
	H.2.2.4 Replication Analysis	H-13
H.3	Quality Assurance and Control Procedures for Field Operations	H-14
H.4	Analysis of Data Uncertainties	H-15
	H.4.1 Protocol Step 1 Reproducibility Study	H-16
	H.4.1.1 Analysis of Protocol Step 1 Reproducibility Using the Uncomposited Samples	H-18
	H.4.1.2 Analysis of Protocol Step 1 Reproducibility Using Composited Samples	H-26
	H.4.2 Analyses of Replication Built into the Experimental Design	H-29
	H.4.2.1 Methods Used to Develop the Uncertainty Data	H-30
	H.4.2.2 Tabulation of Data Uncertainty	H-34
H.5	Comparison of Standard Deviations Computed from the Reproducibility Data and From the Regular Data Base	H-35
H.6	Discussion of Error Analyses	H-37
H.7	References	H-39

List of Tables

Table		Page
H-1	Summary of Laboratory Quality Assurance and Control Procedures	H-5
H-2	Example of ICAPES Calibration	H-8
H-3	Analysis of Synthetic and Laboratory Leachate Samples	H-11
H-4	Composition of Quality Control Sample of ICAPES and AAS	H-12
H-5	Replicate Field Cells and Laboratory Columns for Quality Assurance and Control	H-14
H-6	Coefficients of Variation, Ratios of Means to Detection Limits, and Associated Statistics for Protocol Step 1 Reproducibility Study	H-19
H-7	Relationship Between Coefficient of Variation and Ratio of Mean Concentration to Detection Limit for Protocol Step 1 Reproducibility Study	H-20
H-8	Standard Deviations Associated with Sources of Variance in the Protocol Step 1 Reproducibility Study	H-25
H-9	Statistical Analysis Results for Chemical Analyses of the Five Solid Samples Used in the Protocol Step 1 Reproducibility Study	H-26
H-10	Analysis of Data from Filtered and Unfiltered Samples	H-27
H-11	Standard Error Analysis for Aluminum in Leachates from Field Cells Containing Alliance AFBC Waste and Alluvium (Lower Sample Point)	H-33
H-12 to H-19	(See Attachments 1 to 8)	
H-20	Comparison of Standard Errors Computed from the Protocol Step 1 Reproducibility Study for Alliance AFBC Waste and the Replicates in the Regular Data Base	H-36

List of Figures

Figure		Page
H-1	Example of IC Calibration Curve	H-9
H-2	Flow Chart for the Solids "Representativeness" and Associated Experiment	H-17
H-3	Plot of Coefficient of Variation vs. Ratio of the Mean Concentration to the Detection Limit for the Protocol Step 1 Reproducibility Study	H-21

Attachments

Attachment		Page
1	Table H-12. Uncertainties for Laboratory Data: Leaching Data for Exxon PFBC Waste	H-41
2	Table H-13. Uncertainties for Laboratory Data: Attenuation Data for Exxon PFBC Waste	H-47
3	Table H-14. Uncertainties for Laboratory Data: Leaching Data for Alliance AFBC Waste	H-67
4	Table H-15. Uncertainties for Laboratory Data: Attenuation Data for Alliance AFBC Waste	H-73
5	Table H-16. Uncertainties for Field Data: Upper Sampling Point for Field Cells 1 and 2 (Exxon PFBC Waste and Shale)	H-95
6	Table H-17. Uncertainties for Field Data: Lower Sampling Point for Field Cells 1 and 2 (Exxon PFBC Waste and Shale)	H-101
7	Table H-18. Uncertainties for Field Data: Upper Sampling Point for Field Cells 14 and 15 (Alliance AFBC Waste and Alluvium)	H-107
8	Table H-19. Uncertainties for Field Data: Lower Sampling Point for Field Cells 14 and 15 (Alliance AFBC Waste and Alluvium)	H-111

H.1 Overview

Quality assurance and control (QA/QC) procedures were instituted for both the laboratory and field components of the investigation. Statistical analyses were also performed to quantify data uncertainties. In the laboratory QA/QC procedures, the emphasis was placed on the batch equilibration protocol and the chemical analyses of leachates from both the laboratory and field components of the study. QA/QC procedures were also developed specifically for the field operations. The QA/QC procedures included methods necessary to ensure valid chemical analyses of concentrations, such as equipment calibration and use of standard samples. Also, replicate performances of laboratory shake tests and replicate field cells were employed to allow data variability to be quantified.

A series of analyses of data variability were performed. First, a special study of uncertainties in protocol Step 1 results using Alliance AFBC waste leachate data was conducted. A statistical analysis (variance component analysis) was performed to estimate the contributions of the different sources of error. The concentrations of 20 chemical species, pH, and specific conductance were investigated. In 11 of the 22 cases, the largest contributor was a term whose variance is affected by within day chemical analysis variability and interaction effects involving analysis day and solid subset, if these interaction effects were present. In each of the other 11 cases, the largest source of error was estimated to be either (1) random variations in the solid waste samples, (2) random variability in performing the extractions, or (3) random variability in chemical analysis errors among days.

Also, as part of the special study, an analysis of the differences between filtered and unfiltered results was performed. The differences which

were observed between the filtered and unfiltered results can be explained in terms of random variability.

Analyses of replication built into the design of the regular data base were also performed. Included were data from replicate performances of laboratory shake tests and from replicate field cells. A detailed table of standard deviation of the variability in the measurements shows that, in mose cases, the variability is in the first or second significant figure of the values, although lower relative errors were usually observed for calcium, total dissolved solids, and sulfate concentrations, for pH, and in some cases for other parameters.

The standard errors from (1) the special study of protocol Step 1 reproducibility for Alliance AFBC waste and (2) the Step 1 replicates in the regular data base were compared. The standard errors computed from the regular data base were smaller for 18 of 20 parameters investigated. A probable explanation is that in the reproducibility study, chemical analyses of replicates were performed on different days. Chemical analyses for the Alliance AFBC replicates were performed on the same day. Thus, the effect of day-to-day measurement variance affected the standard error computed for the special study but not the standard errors computed from the regular data base.

The data errors were analyzed from the point of view of adequacy of the data for the statistical modeling studies presented in Appendix G. While a knowledge of the uncertainty in the original data is instructive, an error averaging effect is achieved when a statistical analysis is performed. Thus, the uncertainties in the results of an analysis can be much smaller than the uncertainties in the original data. Although the individual values were subject to random error, the data have been shown to be sufficiently accurate to support a variety of types of analysis.

H.2 Laboratory Quality Assurance and Control Procedures

Rigorous QA/QC procedures were used in sample preparation, leachate generation and attenuation, and chemical analysis of leachates.

H.2.1 QA/QC Procedures for the Batch Equilibration Studies

The laboratory batch equilibration protocol was designed to achieve optimum reproducibility. Preliminary studies for this program and results from previous investigations were used to develop the protocol. As noted in Appendix D, special consideration was given to liquid-to-solid mass ratios, agitation rates and devices, and equilibration periods to provide maximum reproducibility.

Each step of the laboratory batch equilibration protocol was performed in duplicate. In addition, some protocol steps were executed in multiple replicates to generate sufficient liquid for successive protocol steps. When multiple replicates were available, both individual and composited liquid samples were analyzed to determine variation in the eluants produced. An investigation of the differences in composition of individual and composited leachates is described in Appendix D.

During preparation for both the leaching and attenuation steps of the protocol, the same procedures for solids preparation and apparatus preparation were executed to maintain reproducibility. All solids were representatively sampled according to ASTM methods, dried at constant low temperature, and ground to approximately the same particle size. The results of a sample representativeness test are reported in Appendix D and in Section H.4 below. Solid-liquid interactions were carried out with identical agitation devices maintained at a constant rotation velocity for a set amount of time.

Other laboratory procedures were standardized to minimize experimental errors. Leachate containers were pre-washed with dilute nitric acid and rinsed several times with deionized water to prevent container contamination. Each solid and liquid was handled carefully in the same manner each

time a sample was divided, preserved, or carried forward to successive protocol steps. Each phase of leaching and attenuation was followed with care in sample labeling and prompt analysis.

H.2.2 QA/QC Procedures for Chemical Analysis

The QA/QC elements for chemical analysis included the following:

- Calibration of instruments;
- Analysis of spiked synthetic and actual leachate samples;
- Analysis of standard samples of known concentration to validate measurements; and
- Replicate measurements in the laboratory.

Table H-1 summarizes the QA/QC activities which are discussed in further detail below. The individual methods of chemical analysis are set forth in detail in Appendix A.

H.2.2.1 Calibration of Instruments

The standards used for the inductively coupled argon plasma emission spectrophotometer (ICAPES) and ion chromatography (IC) instruments were obtained commercially and were diluted to the desired concentration. Calibration of the instruments was performed on each day that analyses were made. Multipoint calibrations were used. A deionized water blank and standards at three non-zero concentrations were used to cover the range of concentration of interest. The ICAPES instrument automatically performs a regression analysis to determine the calibration curve. Calibration (linear regression) for the IC instrument was performed manually. Table H-2 and Figure H-1 present calibration examples.

TABLE H-1. SUMMARY OF LABORATORY QUALITY ASSURANCE AND CONTROL PROCEDURES

Parameter	Calibration	Spiked Samples	Standard Samples	Replicate Measurements in the Laboratory
		Elements Analyzed by ICAPES[1]		
Al	x	x	x	x
As[2]	x	x	—	x
B	x	x	x	x
Ba	x	x	x	x
Be	x	x	—	x
Ca	x	x	x	x
Cd	x	x	x	x
Co	x	x	x	x
Cr	x	x	—	x
Cu	x	x	x	x
Fe	x	x	x	x
K	x	x	x	x
Li	x	x	x	x
Mg	x	x	x	x
Mn	x	x	x	x
Mo	x	x	x	x
Na	x	x	x	x
Ni	x	x	x	x
Pb[2]	x	x	—	x
Se[2]	x	x	—	x
Si	x	x	x	x
Sr	x	x	x	x
Ti	x	x	x	x
U[2]	x	x	x	x
V	x	x	x	x
Zn	x	x	x	x

(Continued)

NOTE: Inclusion of all elements in the same standard would have caused precipitation.

[1]Inductively Coupled Argon Plasma Emission Spectrometry.

[2]Dropped early in program.

TABLE H-1. (Continued)

Parameter	Calibration	Spiked Samples	Standard Samples	Replicate Measurements in the Laboratory
Elements Analyzed by AAS*				
Hg	x	x	x	x
Se	x	x	**	x
Li	x	x	x	x

*Atomic Absorption Spectrophotometry.
**No standard available.

Parameter Analyzed by Glass Electrode				
pH	Single-point calibration	*	*	x

*None available.

Parameter Analyzed by Selective Ion Electrode				
F	*	Standard additions	**	x

*Standard addition serves the purpose of calibration.
**Not available.

Determination of Specific Conductance				
Specific Conductance	Single-point calibration	*	*	x

*Not available.

Determination of Total Dissolved Solids				
TDS	*	*	*	x

*Done with analytical balance; no electronics involved.

(Continued)

TABLE H-1. (Continued)

Parameter	Calibration	Spiked Samples	Standard Samples	Replicate Measurements in the Laboratory
		Parameters Analyzed by Ion Chromatography		
Cl	x	*	x	x
SO_4	x	*	x	x
		Determination of Total Organic Carbon		
TOC	Single-point calibration	*	*	x

*Normally not done.

*None available.

TABLE H-2. ICPES CALIBRATION EXAMPLE

```
AG                CM # 1
LOW I  HIGH I      B(0)          B(1)          B(2)          B(3)
 12.36   332.4 -.7581703  .4132229E-1  .3246925E-5     0

STD     CONC.      INT.      S.D.   CALC CONC.   CONC ERROR   % ERROR   CURVE
  1     0.0000     12.36     0.09       0.0001       0.0001                 1
  2     0.2000     15.60     0.27       0.1992      -0.0008     -0.38      1
  4     2.0000     44.99     0.92       2.0009       0.0009      0.05      1
  7    20.0000    332.62    12.87      19.9983      -0.0017     -0.01      1
RMS ERROR -      0.19%
```

```
AL                CM # 2
LOW I  HIGH I      B(0)          B(1)          B(2)          B(3)
 12.58   98.02 -3.240579  .2576436  .7252384E-4     0

STD     CONC.      INT.      S.D.   CALC CONC.   CONC ERROR   % ERROR   CURVE
  1     0.0000     12.58     0.18       0.0121       0.0121                 1
  3     0.2000     13.28     0.12       0.1937      -0.0063     -3.14      1
  5     2.0000     30.33     0.09       2.0004       0.0004      0.02      1
  7    20.0000     98.02     0.17      20.0000      -0.0000     -0.00      1
RMS ERROR -      1.57%
```

```
B                 CM # 3
LOW I  HIGH I      B(0)          B(1)          B(2)          B(3)
 9.84   1379. -.3429143  .3592095E-1  .5421019E-6     0

STD     CONC.      INT.      S.D.   CALC CONC.   CONC ERROR   % ERROR   CURVE
  1     0.0000     9.84      0.08      -0.0093      -0.0093                 1
  3     0.5000    24.19      0.04       0.5065       0.0065      1.29      1
  5     5.1578   193.37      0.12       5.1553      -0.0025     -0.05      1
  7    50.1622  1379.00      1.61      50.2028       0.0406      0.08      1
RMS ERROR -      0.62%
```

```
DA                CM # 4
LOW I  HIGH I      B(0)          B(1)          B(2)          B(3)
 17.20   1558. -.2235907  .1296492E-1  .2537044E-7     0

STD     CONC.      INT.      S.D.   CALC CONC.   CONC ERROR   % ERROR   CURVE
  1     0.0000     17.20     0.07      -0.0005      -0.0005                 1
  3     0.2000     32.82     0.12       0.2020       0.0020      1.00      1
  5     2.0000    170.74     0.75       1.9914      -0.0086     -0.43      1
  7    20.0000  1558.27    17.72      20.0437       0.0439      0.22      1
RMS ERROR -      0.56%
```

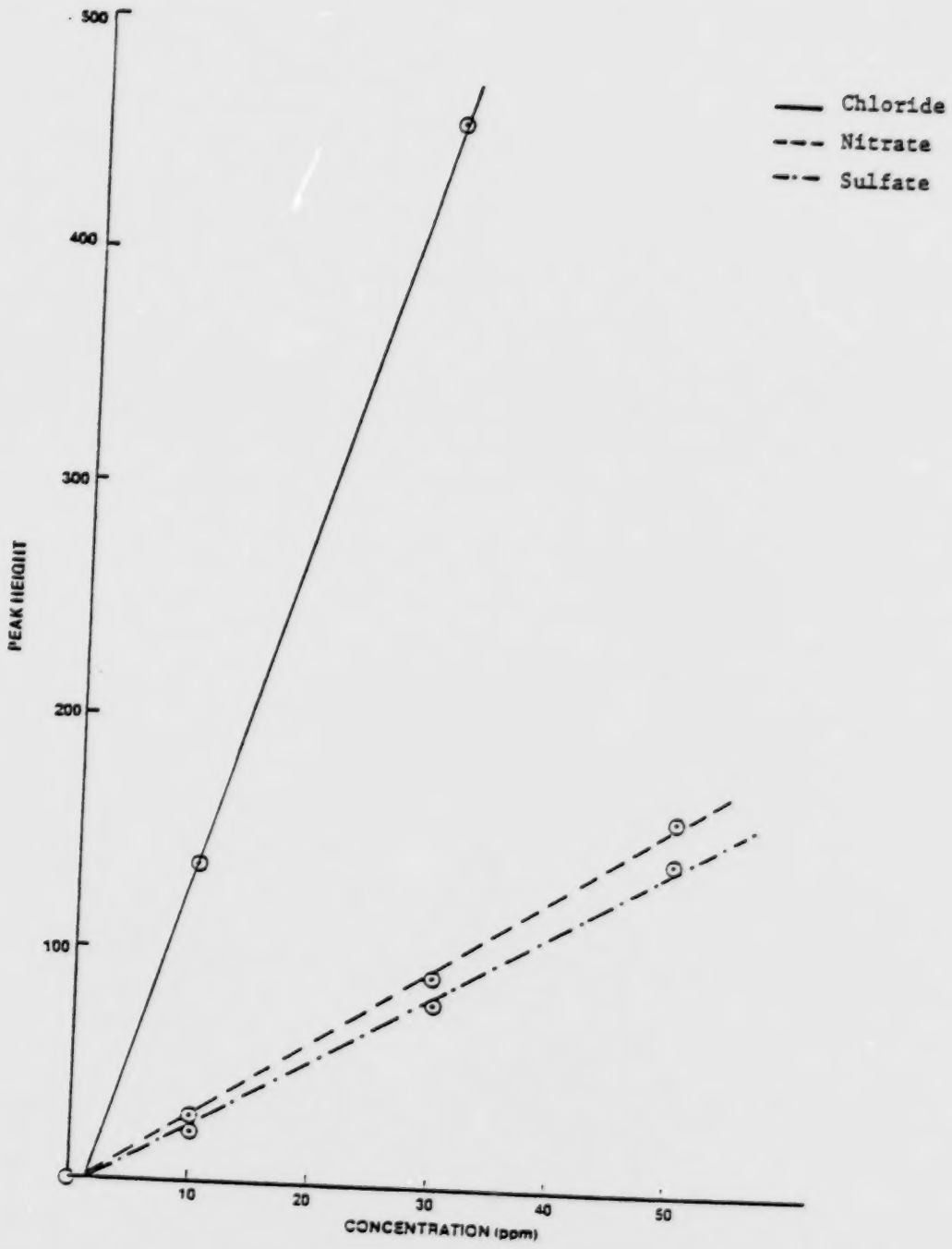


Figure H-1. Example of IC Calibration Curve.

Single-element, multipoint calibrations were performed for the atomic absorption spectrophotometer (AAS). Single-point calibrations were performed for glass electrode, specific conductance, and total organic carbon determinations. Standard addition served the purpose of calibration for the selective ion electrode. In this approach, the sample was analyzed, and two levels of spikes were then added. Analysis of the samples spiked at known levels served as a calibration.

H.2.2.2 Spiked Samples

The use of spikes (or addition of known amounts of a component) was initially employed to define the acceptability of the ICAPES method. Table H-3 presents the spiking results and recovery of spiked components in the analysis for both deionized water and a laboratory leachate sample. The initial samples and spiked samples were analyzed 30 times to provide statistical information. Spikes were also used for AAS determinations. Standard additions, which are analogous to spikes, were performed for selective ion electrode determinations.

The standards were used on a day-to-day basis for quality control purposes. A standard was run each time a calibration was done for the above-mentioned instruments. If the measured concentrations were not within $\pm$10 percent of the known values, the problem was resolved before additional analyses were begun. A quality control standard was also run after every ten samples. Accuracy within $\pm$10% was achieved before the analyses were resumed.

There were two exceptions to the requirement of agreement within $\pm$10% with the known concentrations of the standard. First, if a concentration of a particular element in a multi-element sample was near the detection limit, agreement strictly within $\pm$10% for the element might not be expected. An acceptably small absolute difference between replicates is required, however.

TABLE H-3. ANALYSIS OF SYNTHETIC AND LABORATORY LEACHATE SAMPLES[1]

Element	Deionized Water Sample				Leachate Sample L1701			
	Sample[2]	Spike[2]	Spike + Sample[2]	Spike Recovery (%)	L1701[2]	Spike	Spike + Sample[2]	Spike Recovery (%)
Ag	<0.005	–	<0.005	–	0.040±0.04	–	0.042±0.004	–
Al	<0.060	0.50	0.52±0.01	104	0.84±0.04	0.50	1.40±0.11	112
B	<0.004	1.00	0.95±0.05	95	7.50±0.13	1.00	8.30±0.40	80[3]
Ba	0.004±0.001	0.50	0.48±0.02	96	0.35±0.01	0.50	0.80±0.02	90
Ca	0.010±0.005	5.0	4.80±0.05	96	1470±17	5.0	1470±19	–[3]
Cd	<0.005	0.50	0.47±0.01	94	<0.005	0.50	0.52±0.01	104
Co	<0.15	0.50	0.50±0.01	100	1.4±0.08	0.50	1.97±0.11	114
Cr	<0.005	0.50	0.48±0.02	96	0.07±0.02	0.50	0.53±0.04	92
Cu	<0.005	0.50	0.46±0.02	92	0.01±0.005	0.50	0.49±0.05	96
Fe	<0.005	0.50	0.49±0.03	98	0.045±0.010	0.50	0.049±0.005	89
K	<40	5.0	<40	–	700±10	5.0	760±43	–[3]
Mg	0.002±0.001	0.50	0.49±0.003	98	0.022±0.002	0.50	0.464±0.009	88
Mn	<0.001	0.50	0.45±0.03	92	0.002±0.001	0.50	0.49±0.03	98
Ni	<0.020	0.50	0.48±0.01	96	0.15±0.05	0.50	0.68±0.015	106
Si	<0.020	0.25	0.26±0.008	104	0.60±0.10	0.50	1.08±0.04	96
Sr	<0.001	0.50	0.49±0.02	98	2.85±0.10	0.25	3.05±0.04	80
Ti	<0.001	0.25	0.26±0.005	104	0.056±0.010	0.25	0.290±0.008	94
V	<0.010	0.25	0.24±0.01	96	0.11±0.008	0.25	0.34±0.009	92
Zn	<0.002	0.50	0.47±0.01	94	0.007±0.003	0.50	0.48±0.01	95

[1]All concentrations in mg/L.
[2]Mean ± standard deviation for 30 determinations.
[3]Spikes were too small in comparison with sample concentration to accurately define recovery.

Second, if one element in a multi-element sample varied by slightly over ±10%, the sample would not be rejected. However, if a large variation of, say, 50% or 100% even in one element was observed, the analysis was not accepted.

H.2.2.3 Standard Samples

Analysis of the standard sample described by Table H-4 was performed to check for stability of the ICAPES and AAS instruments. The standard was analyzed after each tenth sample. Lower-level standards were analyzed to define accuracy in the sub-mg/L concentrations. A separate standard was used for the ion chromatography instrument.

TABLE H-4. COMPOSITION OF QUALITY CONTROL SAMPLE FOR ICAPES AND AAS

Element	Concentration (mg/L)
Al	2
B	5
Ba	2
Ca	2
Cd	2
Co	2
Cu	2
Fe	2
Hg	2
K	20
Li	1
Mg	2
Mn	2
Mo	2
Na	6
Ni	2
Se	1
Si	2
Sr	2
Ti	2
V	2
Zn	2

H.2.2.4 Replication Analysis

Replication measurements were performed for 10% of all samples for all instruments. This was accomplished by splitting the sample into two fractions and analyzing each fraction. Each ICAPES analysis consisted of three integrations to provide a mean and standard deviation. Each IC analysis for sulfate and chloride was a single determination with repeat analysis of 10% of the samples. Total dissolved solids were analyzed with duplication analysis of 10% of the samples.

Variation of 10% or less between two replicate analysis was considered acceptable. If variation greater than this was observed, additional analyses were performed to achieve acceptable repeatability if possible. If this was not possible, the sample was not included in the data base. If it was from a laboratory shake test, the test was reperformed if it was an essential step for the project.

As was mentioned in the case of standards measurements, agreement within $\pm$10% was not expected or required if the concentration of an element was near the detection limit. A value within a factor of ten of the detection limit is considered close to it. Also, if only one element in a multi-element sample varied by slightly over $\pm$10% (say, by 15%) the analysis was not rejected on this basis alone.

If a sample analyses was rejected due to lack of repeatability, the intervening measurements since the last replicate run were not automatically rejected. A decision regarding the acceptability of the measurements was made subjectively on the basis of the replicate analysis results, standards measurements, and analyses of blank samples. A blank (deionized water) sample was analyzed after each calibration to verify that the system was working before measurements are made.

H.3 Quality Assurance and Control Procedures for Field Operations

The experimental design of the field studies task included two principal QA/QC elements—two duplicate sets of field cells containing both waste and disposal media, and two control cells containing disposal media but not waste. In addition, there was laboratory control for field operation consisting of a complete set of columns containing disposal media only which were operated at Radian's Austin facility with deionized water input equivalent to the Crown, West Virginia, rainfall.

The two sets of duplicate field cells are shown in Table H-5 along with the corresponding control (disposal media only) field cells and laboratory control columns. The results of leachate analyses on the two sets of cells are compared with each other to evaluate cell-to-cell variation in the text and Appendix D.

TABLE H-5. REPLICATE FIELD CELLS AND LABORATORY COLUMNS FOR QUALITY ASSURANCE AND CONTROL

Field Cells	Waste	Disposal Medium	Corresponding Field Control Cell[1]	Corresponding Lab Control Column[2]
1, 2	Exxon PFBC	Shale	7	B
14, 15	Alliance AFBC	Alluvium	12	C

[1]Field cell with disposal media only.
[2]Laboratory control column with disposal media only.

The field component of QA/QC also consisted of two full-size control cells containing media only at the Crown field site. The analytical results are used the text and in Appendix E to evaluate contaminant contributions from the media themselves when leached by rainfall or by FBC leachate. The results from the field control columns are also compared with those of the corresponding laboratory columns as a measure of the equivalence of the control data elsewhere in this appendix.

H.4 Analysis of Data Uncertainties

Statistical analyses were performed to quantify the uncertainties in the FBC waste leachate data. An analysis of a special study involving protocol Step 1 was performed to investigate specific sources of error. A separate analysis of replications built into the experimental design was performed to quantify data uncertainty for all laboratory protocol steps and for the field data.

Variability in the Step 1 leachate concentration data caused concern over the effectiveness of the ASTM procedures for sample reduction. Additionally, concern arose over the fact that laboratory samples were not filtered before analysis in this study. To address these and other questions, a special study that used protocol Step 1 results with Alliance AFBC waste was performed. This study was performed in two parts. First, a statistical analysis (variance component analysis) was performed of the contributions of the different sources of error, including variation among solid waste samples, variability in performing the laboratory shake tests, and chemical analysis. Second, an analysis of the differences between analytical results from filtered and unfiltered samples was performed.

Subsequently, an evaluation of data uncertainty through analysis of replication built into the design was made. Analyses of the following were performed:

1. Data from replicate performances of laboratory shake tests, and

2. Data from replicate field cells (i.e., cells with the same waste and disposal medium). The differences among replicates were used to quantify data uncertainty.

H.4.1 Protocol Step 1 Reproducibility Study

As noted, a special study of the reproducibility of the protocol Step 1 results was performed using Alliance AFBC waste. Figure H-2 displays the experimental design. Approximately 10 kilograms of the waste were mixed, and five separate waste samples of about 250g each, shown as A, B, C, D, and E in the figure, were removed. Each waste sample was thoroughly mixed and divided into components, two of which were used to perform Step 1, seven-day extractions. The extractions from the two components, labeled X and Y, were performed using a 50g:500 mL solid:liquid ratio. The X leachates were each divided into four portions and analyzed on separate days. The measurements were made at two-week intervals (plus or minus one day) for ICAPES elemental analysis, and at approximately one-month intervals for wet chemistry analysis. Of the parameters listed in Table H-1, specific conductance, Cl, F, pH, SO_4, TDS, and TOC measurements fall under the category of wet chemistry. The same set of analysis days, labeled 1, 2, 3, and 4, were used for each set of four X-extractions.

From each Y-extraction, a 150 mL portion was retained to analyze with the first of the X-samples. The remaining 300 mL from each of the Y-extractions were combined into one large composite sample. One half of the composite was filtered and the other half was not. Each of the two portions was then subdivided into four aliquots, which were numbered 1-4 and analyzed along with the X-extractions. The experiment using composited samples is illustrated in the lower right-hand part of Figure H-2.

The extractions using the composited leachates are considered to be qualitatively different from the other extractions described above. Thus, the results with and without compositing were analyzed statistically as two separate experiments.

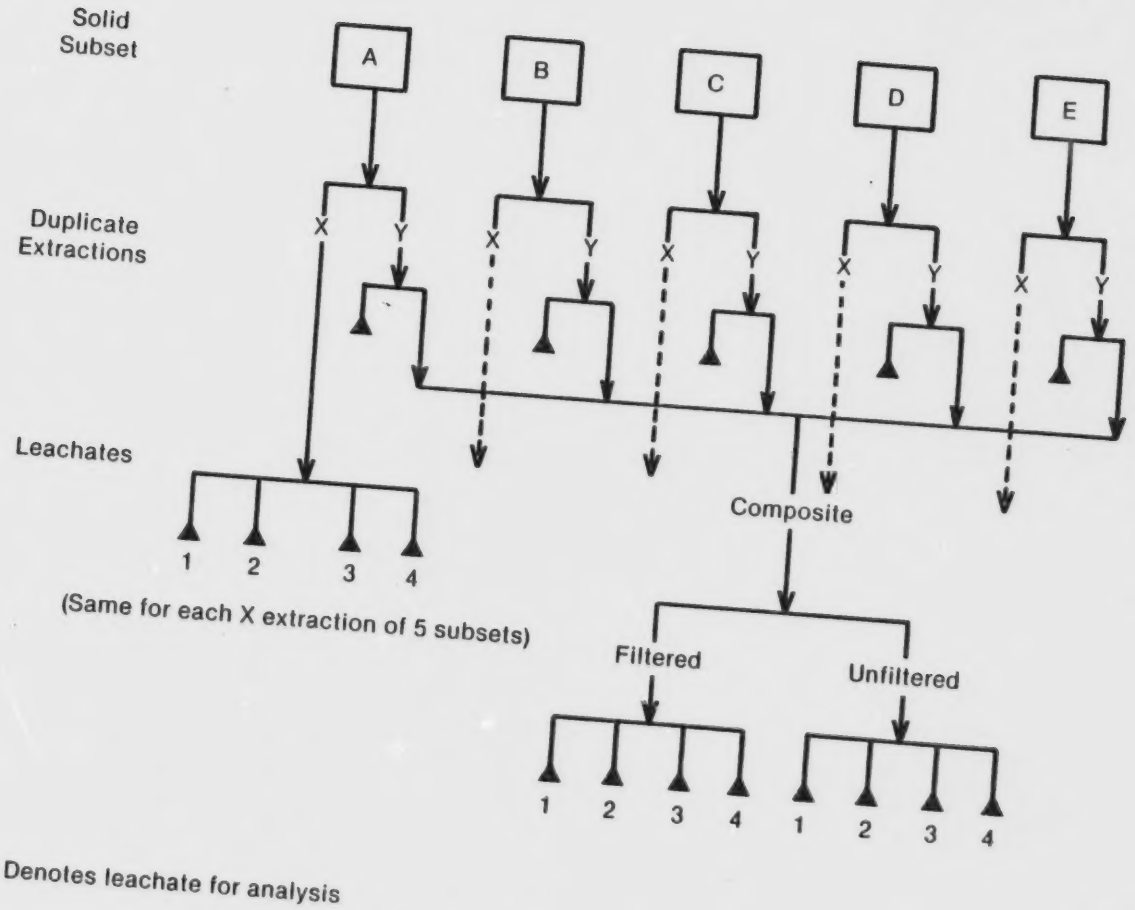


Figure H-2. Flow Chart for the Solids "Representativeness" and Associated Experiment.

H.4.1.1 Analysis of Protocol Step 1 Reproducibility Using the Uncomposited Samples

The reproducibility experiment involving the uncomposited Alliance AFBC waste leachates was designed to allow the separate sources of random error to be quantified. These sources include (1) variations in composition of the waste samples, (2) variations in the performance of the shake test itself, and (3) chemical analytical error. Since the replicate measurements were performed on separate days, the analytical error includes day-to-day effects, such as random errors in separate equipment calibrations.

Before the analysis of components of error is discussed, however, a set of simple descriptive measures of the total error and its relationship to the detection limit is necessary. The set of 25 measurements (four Y-leachates and one X-leachate for each of five waste samples) are related in a prescribed way and technically do not constitute a random sample of independent measurements. Nevertheless, the statistical measures of the data as a whole (Table H-6) constitute an initial look at the error properties and provide some insights. There are 25 observations for all parameters except total organic carbon, for which there are only 14 observations due to missing values.

For several of the species analyzed chemically, the concentrations were predominantly undetected. These species include Cd, Co, Fe, Mn, Ni, Si, Ti, TIC, and Zn. Since variability among undetected values is not considered to be of practical importance, undetected values have been stored in the data base as "less than the detection limit." The variability among the concentrations of predominantly undetected species was not analyzed statistically.

The mean, standard deviation, and coefficient of variation are given in Table H-6. The standard deviation is a basic measure of the variability among the 25 values; the standard deviation would be zero if there were no random error from any of the sources listed above. The coefficient of variation is simply the standard deviation divided by the mean; i.e., it is a measure of relative error.

TABLE H-6. COEFFICIENTS OF VARIATION, RATIOS OF MEANS TO DETECTION LIMITS, AND ASSOCIATED STATISTICS FOR PROTOCOL STEP 1 REPRODUCIBILITY STUDY[1]

Element/ Species	Mean	Deviation	Coefficient of Variation	Detection Limit	Ratio of Mean to Detection Limit
Al	0.89	0.51	0.57	0.25	3.6
B	0.28	0.18	0.64	0.05	5.6
Ba	0.42	0.062	0.15	0.005	84
Be	0.0064	0.0035	0.55	0.002	3.2
Ca	1600	150	0.094	0.2	8000
Cl	53	4.0	0.076	2	27
Cr	0.032	0.026	0.81	0.005	6.4
Cu	0.019	0.012	0.63	0.005	3.8
F	0.20	0.085	0.43	0.05	4.0
K	57	6.3	0.11	0.2	290
Li	0.45	0.096	0.21	0.005	90
Mg	0.65	0.26	0.40	0.15	4.3
Mo	0.34	0.11	0.32	0.01	34
Na	19	2.3	0.12	0.05	380
pH[2]	12	0.87	0.073	–	–
SO_4	1400	120	0.086	10	140
Sp. Cond.[3]	7400	1000	0.14	–	–
Sr	22	2.3	0.10	0.005	4400
TDS	3900	350	0.090	50	78
TOC	4.7	5.2	1.1	0.5	9.4
V	0.12	0.069	0.58	0.015	8.0

[1]Concentrations are in mg/L unless otherwise noted.
[2]Units are standard pH units.
[3]Units are micromhos/cm.

The standard deviation of 0.87 for pH reflects a single low value of 8.02. The rest of the pH values fell between 12.31 and 12.52. Otherwise outliers were not observed.

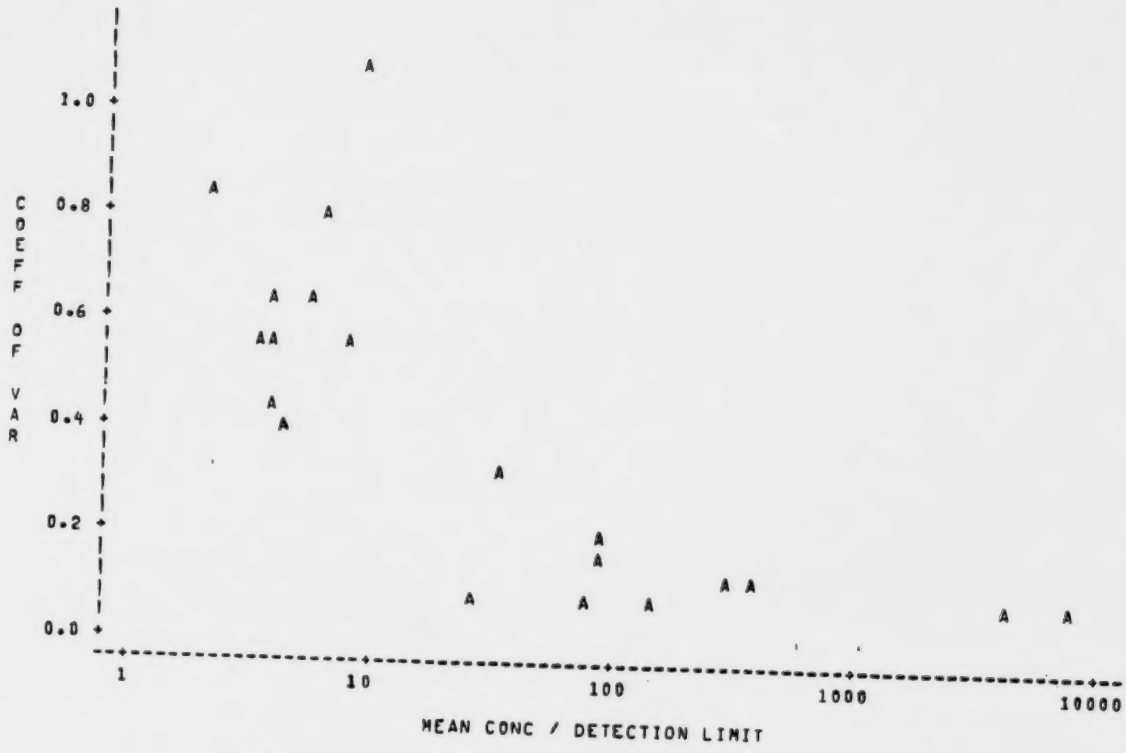
The detection limit and the ratio of the mean to the detection limit are also given in the table. When the ratio is small, the measurements are near the detection limit, and large relative chemical analytical errors (large coefficients of variation) would be expected. Thus, the ratio of the mean to the detection limit provides a mechanism for interpreting the errors.

Table H-7 and Figure H-3 show that, as expected, the relative error generally decreases with distance from the detection limit. The concentration is more than ten times the detection limit in ten cases (Ba, Ca, Cl, K, Li, Mo, Na, SO_4, Sr, and TDS). The coefficient of variation is less than or equal to 0.12 in eight of these cases and has a maximum of 0.32 (for molybdenum). For the six cases (Ag, Al, Be, Cu, F, and Mg) in which the mean-to-detection-limit ratio is less than five, the coefficient of variation is greater than 0.2 in all cases and is greater than 0.5 in four cases.

TABLE H-7. RELATIONSHIP BETWEEN COEFFICIENT OF VARIATION AND RATIO OF MEAN CONCENTRATION TO DETECTION LIMIT FOR PROTOCOL STEP 1 REPRODUCIBILITY STUDY

Coefficient of Variation	Ratio to Mean Concentration to Detection Limit		
	0 to 5	5 to 10	>10
<0.1	-	-	Ca,Cl,SO_4, TDS
0.1 to 0.2	-	-	Ba,K,Na,Sr
0.2 to 0.5	F,Mg	-	Li,Mo
>0.5	Ag,Al,Be,Cu	B,Cr,TOC,V	-

It is clear from Figure H-3, however, that the relationship between relative error and proximity to the detection limit contains a consideralbe scatter. This is probably largely because the errors from other sources (solids composition variability, variability among replicate shake tests) are not necessarily related to the instrument detection limit.



NOTE: A = Plot of one chemical parameter (Ag, As, etc.).

Figure H-3. Plot of Coefficient of Variation vs. Ratio of Mean Concentration to the Detection Limit for the Protocol Step 1 Reproducibility Study.

The analysis above characterizes the total experimental error. It is of interest also to quantify the contributions of different sources to the error. Consider the following model:

$$C = \mu + e_S + e_E + e_A + e_I$$

where

C is the measured concentration (with error),

μ is the true, but unknown, concentration,

e_S is the error in C due to random variations in the solid waste samples,

e_E is the error in C due to random variability in performing the extractions,

e_A is the random chemical analysis error associated with a particular analysis day, and

e_I is the remaining part of the error which cannot be explained in terms of e_S, e_E, and e_A.

The term e_A represents uniform variations in measurement error from analysis day to analysis day. Since a new calibration is performed on each analysis day, and all measurements of a given species are affected by that calibration, calibration error influences e_A. Any other day-to-day factor, such as change of equipment operations, potentially affects e_A. The e_A term does not represent within-day chemical analysis variability (i.e., variability caused by electronic drift).

An additional possible contributor to variation among analysis days is a temporal trend in the composition of the leachate samples. While four time points are not adequate to define a curve accurately, a consistent trend was observed only for sulfate. In the four X-measurements for each waste sample, the sulfate concentration decreased from 1600 mg/L to 1380 mg/L for Sample A, from 1570 to 1350 mg/L for Sample B, from 1410 to 1340 for Sample C, from 1480 to 1350 for Sample D, and from 1480 to 1150 for Sample E. The sulfate concentration was nonincreasing in each time step for four of the five waste samples (A, B, C, E).

The term e_I represents the part of the error which cannot be explained by the simple, additive terms e_S, e_E, and e_A. The term e_I in this experimental design is affected in part by interactive (nonlinear) effects involving analysis day and solid subset, if such effects are present. It is possible for this interaction to exist. Suppose, for example, that the true concentrations in the leachates from one solid sample were lower than those from another sample. Then the measurements for the two samples would be affected by different parts of the calibration curve. Thus, the calibration-related errors for that analysis day could differ consistently between the two waste samples. Moreover, the differences between the calibration errors for the two waste samples would be expected to vary among analysis days, since recalibrations are performed each day. Thus, the interaction error would not be accounted for by e_A, since e_A accounts for errors which are consistent among analysis days. The term e_I is also affected by within-day chemical analysis variability, a factor not accounted for by the terms e_S, e_E, and e_A.

The objective, then, is to quantify the standard deviation associated with each of the e-terms. This can be accomplished with variance component analysis (References H-1 and H-2). In analysis-of-variance terms, there are four degrees of freedom for the solids effect, five degrees of freedom for the extraction replication, three for the analysis day effect, and twelve remaining for the e_I effect. The number of degrees of freedom is the number of independent pieces of information available. For example, there are five solid samples, but one degree of freedom is employed to estimate the overall mean value, $\bar{c}$. Thus, the variance s^2,

$$s^2 = \frac{\sum_{i=1}^{5} (C_i - \bar{c})^2}{4}$$

where C_i is the average concentration of a given species for the i^{th} waste sample, based on 5-1 = 4 degrees of freedom.

For total organic carbon, for which there are some missing values, there are four degrees of freedom for the solid effect, five for extraction replication, one for the day effect, and three for e_I.

It should be noted that s^2, above, includes the effects of chemical analytical error and extraction-related error as well as variability among solid samples. The mathematics of variance component analysis, mentioned above, is required to compute the error contributions of isolated effects.

Table H-8 presents the results of the variance component analysis for the Alliance AFBC Step 1 leachates. The overall means and standard deviations are given for comparison. Also, the standard deviation is given for each of the four error terms discussed above. The rightmost column summarizes the results of the table. The largest contributor, or contributors, to the total error variance are given for each species. Also, the coefficients of variation for the largest contributors are presented. Again, the coefficient of variation is a measure of relative error. For example, for strontium the mean concentration is 22 mg/L and the error term for shake test replication has the largest standard deviation, 3.0 mg/L. Thus, the coefficient of variation for this error term is:

$$\frac{3.0}{22} = 0.14$$

In some instances, the variance component analysis produced negative estimates of standard deviations. This is due to random sampling error and in all probability would not occur if the sample size were large (say, if 30 degrees of freedom existed for each effect). Since negative standard deviations actually are not possible, zero is the best estimate of standard deviations estimated to be negative. No negatives with large estimates were obtained (all are smaller in magnitude than the largest positive value for the same chemical parameter).

Table H-9 presents the mean, standard deviation, and coefficient of variation for separate analysis of the compositions of the five waste fractions from the Alliance AFBC waste. The coefficients of variation for the

TABLE H-8. STANDARD DEVIATIONS ASSOCIATED WITH SOURCES OF VARIANCE IN THE PROTOCOL STEP 1 REPRODUCIBILITY STUDY[1]

Element/ Species	Mean	Deviation	Standard Deviations Associated with Sources of Variance				Largest Contributor(s) to Variance	Coefficient of Variation for Largest Contributor(s)
			Solids (e_S)	Replication (e_E)	Day (e_A)	Error (e_I)		
Al	0.89	0.51	0.43	0.16	0.10	0.28	Solids	0.48
B	0.28	0.18	0[2]	0.20	0.031	0.055	Replication	0.71
Ba	0.42	0.062	0.038	0	0.053	0.054	Error, Day	0.13,0.13
Be	0.0064	0.0035	0.0011	0	0	0.0038	Error	0.59
Ca	1600	150	0	160	60	81	Replication	0.051
Cl	53	4.0	0	2.2	4.2	1.3	Day	0.079
Cr	0.032	0.026	0.025	0.0054	0.0062	0.010	Day	0.19
Cu	0.019	0.012	0.012	0	0.0039	0.0064	Error	0.34
F	0.20	0.085	0.045	0	0.049	0.072	Error	0.36
K	57	6.3	1.7	2.9	3.7	4.4	Error	0.077
Li	0.45	0.096	0.063	0	0	0.092	Error	0.20
Mg	0.65	0.26	0.21	0.11	0	0.15	Solids	0.32
Mo	0.34	0.11	0.023	0.0533	0.041	0.054	Error, Rep.	0.16,0.16
Na	19	2.3	0	1.9	1.0	1.7	Replication, Error	0.10,0.089
pH[3]	12	0.87	0.54	0	0	0.98	Error	0.082
SO_4	1400	120	0	99	90	62	Replication, Day	0.071,0.064
Sp. Cond.[4]	7400	1000	740	0	420	930	Error	0.13
Sr	22	2.3	0	3.0	1.2	1.0	Replication	0.14
TDS	3900	350	78	0	290	240	Day, Error	0.074,0.062
TOC	4.7	5.2	0.66	3.4	1.7	3.8	Error, Replication	0.81,0.72
V	0.12	0.069	0.070	0	0	0.038	Solids	0.58

[1]Concentrations are in mg/L unless otherwise noted.
[2]Where negative variance components were computed, zeros are reported.
[3]Units are standard pH units.
[4]Units are micromhos/cm.

solids analysis are less than 0.20 in 13 of 18 cases and less than 0.10 in 10 cases. Due to the possibility of differing solubilities and chemical matrix effects in the leaching studies, there is not a perfect association between solid composition and protocol Step 1 results. Moreover, the variances from the solids characterization are influenced by chemical analysis error, whereas the solid variance component is an estimate of the isolated effect of solid sample variability. Comparison of Tables H-8 and H-9 reveals that the coefficient of variation of the solids error term in the variance component analysis is sometimes much larger than the coefficient of variation in the solids analysis (e.g., for aluminum, magnesium, and vanadium).

TABLE H-9. STATISTICAL ANALYSIS RESULTS FOR CHEMICAL ANALYSES OF THE FIVE SOLID SAMPLES USED IN THE PROTOCOL STEP 1 REPRODUCIBILITY STUDY

Element/ Species	Mean (µg/g)	Standard Deviation (µg/g)	Coefficient of Variation
Al	18000	550	0.030
B	520	160	0.31
Ba	200	16	0.082
Be	26	0.45	0.017
Ca	340,000	7100	0.021
Cl	840	22	0.026
Cr	61	17	0.28
Cu	27	13	0.49
F	270	16	0.059
K	3300	320	0.096
Li	18	2.8	0.15
Mg	3700	170	0.045
Mo	22	1.8	0.082
Na	1100	200	0.18
SO_4	120,000	15,000	0.12
Sr	560	11	0.021
V	58	8.1	0.14

H.4.1.2 Analysis of Protocol Step 1 Reproducibility Using Composited Samples

An analysis was also made of the composited data from the Step 1 reproducibility study. Table H-10 presents the mean, standard deviation,

TABLE H-10. ANALYSIS OF DATA FROM FILTERED AND UNFILTERED SAMPLES[1]

Element/ Species	Detection Limit	Filtered			Unfiltered			Mean Difference Significant?
		Mean	Standard Deviation	Coefficient of Variation	Mean	Standard Deviation	Coefficient of Variation	
Al	0.25	1.7	0.86	0.51	1.6	0.79	0.49	No
B	0.05	0.28	0.43	0.15	0.25	0.045	0.18	No
Ba	0.005	0.49	0.19	0.39	0.48	0.21	0.44	No
Be	0.002	0.0045	0.0013	0.29	0.0028	0.00096	0.34	No
Ca	0.2	1600	130	0.081	1600	130	0.081	No
Cl	2	52	4.9	0.094	52	3.4	0.065	No
Cr	0.005	0.035	0.0075	0.21	0.034	0.011	0.32	No
Cu	0.005	0.027	0.0091	0.34	0.031	0.0051	0.17	No
F	0.05	0.12	0.083	0.69	0.15	0.056	0.37	No
K	0.2	58	7.6	0.13	57	6.1	0.11	No
Li	0.005	0.43	0.046	0.11	0.45	0.067	0.15	No
Mg	0.15	0.95	0.36	0.38	0.84	0.36	0.43	No
Mo	0.01	0.27	0.078	0.29	0.26	0.073	0.28	No
Na	0.05	22	3.6	0.16	21	3.3	0.16	No
pH[2]		12.3	0.24	0.020	12.3	0.050	0.041	No
SO_4	10	1460	31	0.021	1410	78	0.055	No
Sp. Cond.[3]		6200	1800	0.29	6800	940	0.14	No
Sr	0.005	22	0.96	0.044	23	1.5	0.065	Yes
TDS	50	3700	340	0.091	3500	570	0.16	No
TOC	0.5	3.3[4]	–	–	5.5[5]	6.4	1.2	–
V	0.015	0.12	0.039	0.33	0.12	0.035	0.29	No

NOTE: The significance tests were performed at the 0.10 level using two-way analysis of variance. For all parameters except TOC, the day effect has three degrees of freedom, the filtered vs. unfiltered effect has one, and the error term has three.

[1]Concentrations are in mg/L unless otherwise noted.
[2]Units are standard pH units.
[3]Units are micromhos/cm.
[4]Based on one data point.
[5]Based on two data points.

and coefficient of variation for each chemical parameter within the filtered and unfiltered categories. Comparison of the means reveals the average difference between filtered and unfiltered results. The standard deviations quantify the differences among analysis days. The coefficient of variation, defined as the mean divided by the standard deviation, reflects the relative day-to-day variability.

Additionally, analysis of variance methods were used to test whether the differences between the means for the filtered and unfiltered data are statistically significant. Significance was found for only one species, strontium. In this instance, the means for the filtered and unfiltered cases are 22 and 23, respectively. Thus, the difference may not be of practical importance, even though it is statistically significant.

The largest relative difference occurred for beryllium, for which the means for the filtered and unfiltered cases are 0.0045 and 0.0028, respectively. This difference is almost statistically significant. (It could be considered significant at the 0.14 level; i.e., there is a 14% probability that the observed difference could have occurred by random chance even if no true difference existed. A difference is ordinarily considered significant, however, if this error probability is less than 10%.)

Moreover, since the hypothesis tests were performed at the 0.10 level, one would expect 10% of the cases to be significant by random chance alone, if the errors were statistically independent. Since 22 hypothesis tests were performed, fewer than the chance number of significant differences were observed.

Another issue concerns the possibility of temporal trends over the analysis days, which were spaced by approximately two weeks. No consistent trends were observed. For sulfate, a decreasing trend was observed for the uncomposited data, discussed above. In the composited data analyzed here, sulfate dropped from 1500 to 1430 mg/L for the filtered case and from 1500 to 1420 mg/L in the unfiltered case in the first time step but oscillated in subsequent time steps. For several species (Al, Ca, K, Mg, Na, Sr, V, and

Li), the lowest concentrations for both the filtered and unfiltered samples were observed on the last analysis day, but no consistent trend was observed for the other days. Thus, the final low values could be the beginning of a trend or simply an effect of the calibration performed on the final day. For two species, barium and molybdenum, the largest concentrations were observed on the final day. Again, no consistent trend was observed for the other days.

Compositing samples has an averaging effect. One would expect the compositing to reduce the variability in the concentrations, pH, and specific conductance values due to variability in solid sample compositions and performances of the shake tests. Compositing should not affect the chemical analysis error. Comparison of Tables H-6 and H-10 shows that the coefficients of variation are lower in the experiment with compositing in about two-thirds of the cases--for 14 of 21 cases for filtered samples and 14 of 22 cases for unfiltered samples.

H.4.2 Analyses of Replication Built into the Experimental Design

The experimental design for the program included replication in the data collected both in the laboratory and in the field. The replicates were used to quantify the uncertainties in the data. Replication in the laboratory consisted of two to eight independent replications of the shake tests. This was done for each combination of analysis procedure, including waste, attenuation medium, protocol step, and repetition within protocol step. The standard error was used as the basic measure of repeatability. The standard error is simply the standard deviation of the variation among replicate values. The measurements for a given step number within a protocol step were combined to calculate a pooled standard error for each protocol step within the above mentioned groups. "Pooling" is a statistical technique which allows several sets of replicates to be used together to estimate a standard error. Pooling is advantageous since increasing the number of data points used increases the accuracy of the standard error calculated. The exact procedures used in pooling and a numerical example are presented below.

As noted, replicates for the field data consist of two sets of duplicate columns. Each pair had a common waste and disposal medium. Data were collected from the duplicate cells on the same days over a period of time. The standard errors presented were pooled over days. The variance was estimated separately for the upper and lower sample points.

H.4.2.1 Methods Used to Develop the Uncertainty Data

The first step in the development of the uncertainty data was to calculate the standard deviation for each pair or group of replicates. The standard deviation is calculated as

$$S = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N-1}}$$

where

x_i, i = 1 to N, are the individual values,
N is the number of replicates, and
$\bar{x}$ is the mean of the replicates.

The term N-1 in the above equation is the number of degrees of freedom. In the case of the field data where there were duplicate samples, N equals 2, and there is one degree of freedom for each pair.

The standard deviations were pooled or combined for both the laboratory and for the field data. For the laboratory data, the pooling was done over multiple repetitions within a protocol step. For the field data, the pooling was done over the days on which the measurements were made. The sum of squares (SS) is:

$$SS = \sum_{j=1}^{K} (S_j^2) * df_j$$

where

S_j^2 is the squared standard deviation of the jth group,

K is the total number of sets of replicates for a given subset (by waste, disposal medium, level, etc.), excluding any set with missing or undetectable values, and

df_j is the sample size minus one for the jth group. For the field data, the number of degrees of freedom is 1. For the laboratory data, it depends on the number of replicates.

The standard error (SE) is calculated as follows:

$$SE = \sqrt{\frac{SS}{\sum_{j=1}^{K} df_j}}$$

where SS has just been defined, and

$\sum_{j=1}^{K} df_j$ is the sum of the degrees of freedom for the group in question.

In the case of the field data tables, the number of degrees of freedom corresponds to the number of complete pairs of duplicates, since each pair has one degree of freedom.

As is discussed above, the standard error presented is an estimate of the true standard error, which would be obtained if an infinite set of replicates were available. The confidence limits which contain the true standard error with 90% probability are also computed.

The confidence intervals were calculated by statistical methods, which involve use of the chi-square (χ^2) distribution. This distribution is not symmetric, as can be seen by examining the position of the standard error between the upper and lower limits. The confidence limits are calculated as follows:

$$\text{Upper limit} = \frac{SE^2}{\chi^2(df)_{P.05}}$$

where

SE^2 is the squared standard error already discussed,

$\chi^2(df)_{P.05}$ is the chi-squared value such that the probability that a chi-squared random variable is less than this value is 5%.

$$\text{Lower limit} = \frac{SE^2}{\chi^2(df)_{P.95}}$$

The lower limit differs from the upper limit only in the probability value. The above calculation of the limits is based on the following inequality:

$$\chi^2(df)_{P.05} < \frac{SE^2}{\sigma_x^2} < \chi^2(df)_{P.95}$$

where σ_x is the true but unknown standard error.

Table H-11 presents a small subset of the data for one parameter, aluminum, and the standard errors calculated by the procedures outlined above. The confidence interval for the level 0.1 to 1 is obtained as follows:

$df = 6$

$\chi^2(6)_{P=.05} = 1.64$

$\chi^2(6)_{P=.95} = 12.59$

$$\text{Upper limit} = \frac{1.0878}{1.64} = 0.816$$

$$\text{Lower limit} = \frac{1.0878}{12.59} = 0.294$$

The $\chi^2(6)_{P=.05}$ and $\chi^2(6)_{P=.95}$ are obtained from standard statistical tables.

TABLE H-11. STANDARD ERROR ANALYSIS FOR ALUMINUM IN LEACHATES FROM FIELD CELLS CONTAINING ALLIANCE AFBC WASTE AND ALLUVIUM (LOWER SAMPLE POINT)

Date	Field Cell 14	Field Cell 15	Mean	Level	SE
3/31/80	1.118	1.607	1.3625	1 to 10	0.3458
4/4/80	2.357	1.437	1.8970	1 to 10	0.6505
4/10/80	1.596	1.641	1.6185	1 to 10	0.0318
4/19/80	1.027	1.269	1.1480	1 to 10	0.1711
5/12/80	0.869	0.950	0.9095	0.1 to 1	0.0573
5/20/80	0.980	1.066	1.0230	1 to 10	0.0608
7/23/80	0.660	0.270	0.4650	0.1 to 1	0.2758
9/3/80	0.730	0.370	0.5500	0.1 to 1	0.2546
10/20/80	0.260	1.500	0.8800	0.1 to 1	0.8768
11/28/80	0.390	0.200	0.2950	1 to 10	0.1344
2/3/81	38.000	23.000	30.50	10 to 100	10.6066
4/24/81	0.260	0.820	0.54	0.1 to 1	0.396

Level	SS	df	Pooled Standard Error
0.1 to 1	1.0878	6	0.426
1 to 10	0.5767	5	0.340
10 to 100	112.5000	1	10.6066

H.4.2.2 Tabulation of Data Uncertainty

Separate tables of uncertainties for the laboratory data are given for each waste (Exxon PFBC and Alliance AFBC) and for each process (leaching and attenuation/mobilization) in Tables H-12 through H-15 (see Attachments 1 to 4). The process groups are divided by protocol step. Leaching is performed in Steps 1 through 3, and attenuation is performed in Steps 4 through 6. The tables are further grouped by the method of analysis (ICAPES, called ICPES in the tables; atomic absorption specrophotometry, and the methods that can be classified as wet chemistry). Within the results for a given analytical method, the uncertainties are ordered by disposal medium and then by parameter. For a given parameter, the data are ordered by the protocol step. Because of analytical problems discovered for silver on the ICAPES data, the entries for silver in Tables H-12 to H-15 should be ignored.

The last factor to affect the order of presentation of the uncertainties is called "Range of Values" in the tables. It is determined in the following way. For each group of replicates, a mean value is calculated. The range of values, i.e., the order of magnitude, of a group is determined from this mean. The groupings by range of values were used because it was not considered valid *a priori* to assume that the standard error was constant with concentration level. Any group of replicates with one or more values either measured at the detection limit or missing was excluded.

Each standard error was computed from a finite sample and, thus, is an estimate of the true standard error; the "true" standard error is the value which would be obtained if an infinite sample size were available. To quantify the uncertainty in the estimated standard error, 90% confidence limits are presented. These confidence limits contain the true standard error with 90% probability. The interval defined by the confidence limits becomes narrower as the sample size increases.

The next group of tables, H-16 through H-19 (see Attachments 5 to 8), presents the uncertainties for the field data. The entries for silver in these tables should again be ignored. Since erratic behavior was observed

in the first week of operation of the field cells, data from this period were excluded. Separate tables are given for each pair of replicate cells (1 and 2; 14 and 15) and each sampling point (upper and lower). Exxon PFBC waste and shale were placed in field cells 1 and 2, and Alliance AFBC waste and alluvium were used in field cells 14 and 15. The tables are further ordered by the method of analysis and the parameter that was measured. The column labeled "Range of Values" was determined in the manner described above for the laboratory data. The duplicate samples were collected on the same days. The standard errors are estimates that are pooled over days. As before, if either of the duplicate values is missing or at the detection limit, the values were not included.

Due to their detailed nature, the tables do not lend themselves to an easy synopsis. However, an inspection of the tables reveals that in most cases, the uncertainty is in the first or second significant figure. For example, for a set of concentrations whose mean is between 1 and 10, the standard deviation of the error in the individual measurements is typically between 0.01 and 5. This general statement applies for both laboratory and field data for leaching and attenuation. The relative errors for calcium, total dissolved solids, and sulfate are smaller than average, usually falling in the second or third significant figure. The uncertainties for pH often fall in the third or fourth significant figure.

While a knowledge of the uncertainties in the original data is useful, it must be remembered that an error averaging effect is achieved in performing analyses using the data. Thus, the uncertainties in the results of an analysis can be much smaller than the uncertainties in the original data if the sample size is large. This point is pursued in Section H.6.

H.5 Comparison of Standard Deviations Computed from the Reproducibility Data and From the Regular Data Base

Table H-20 compares standard errors computed from the Step 1 reproducibility study and the Step 1 replicates in the regular data base. All

TABLE H-20. COMPARISON OF STANDARD ERRORS COMPUTED FROM THE PROTOCOL STEP 1 REPRODUCIBILITY STUDY FOR ALLIANCE AFBC WASTE AND THE REPLICATES IN THE REGULAR DATA BASE[1]

Element/ Species	Reproducibility Study[2]		Analysis of Replicates in the Regular Data Base				
	Mean	Standard Deviation	Mean	Number of Degrees of Freedom	Standard Deviation	90% Confidence Limits Lower	Upper
Al	0.89	0.51	0.49	7	0.070	0.049	0.13
B	0.28	0.18	1.5	7	0.34	0.24	0.61
Ba	0.42	0.062	0.23	7	0.014	0.0099	0.025
Be	0.0064	0.0035	0.0023	7	0.00071	0.00050	0.0013
Ca	1600	150	1500	5	75	50	160
Cl	53	4.0	53	7	0.92	0.65	1.7
Cr	0.032	0.026	0.061	7	0.011	0.0077	0.020
Cu	0.019	0.012	0.043	7	0.011	0.0077	0.020
F	0.20	0.085	0.37	7	0.048	0.034	0.085
K	57	6.3	36	7	3.1	2.2	5.5
Li	0.45	0.096	0.27	7	0.021	0.015	0.037
Mo	0.34	0.11	0.38	7	0.017	0.012	0.030
Na	19	2.3	11	7	0.61	0.43	1.1
SO_4	1400	120	1100	7	18	13	32
Sr	22	2.3	22	5	1.2	0.83	2.6
TDS	3900	350	3900	7	58	41	110
TOC	4.7	5.2	1.2	1	0.99	0.51	16
V	0.12	0.069	0.11	7	0.029	0.020	0.051
pH	12	0.87	13	7	0.024	0.017	0.044
Sp. Cond.[3]	7400	1000	8300	7	180	130	330

[1]Concentrations are in mg/L unless otherwise noted.
[2]There are 25 observations in the reproducibility study for all parameters except TOC, for which there are 14.
[3]Units are micromhos/cm.

data in this table are also presented in the quality assurance tables discussed in the preceding sections. They are repeated here, however, for the purpose of comparison. Only parameters for which error analyses are quotable from both the special reproducibility study and for protocol Step 1 for the regular data base are included.

The table shows that the standard errors computed from the regular data base were smaller in all cases except for boron and beryllium. Close agreement would not be expected, since the standard deviations computed from the regular data base are based on eight points at most. Thus, these standard deviations are subject to random variability and have rather wide confidence limits. Moreover, the chemical analyses for the reproducibility study were done on different days, and the analyses for the regular data base for protocol Step 1, Alliance AFBC waste, were all performed on the same day. Thus, the effect of day-to-day measurement variance (due to separate equipment calibrations, possibly different equipment operators, etc.) is one possible reason that the standard deviations were higher for the reproducibility study. In one instance, the larger standard error for the reproducibility study was due to a single deviant point.

H.6 Discussion of Error Analyses

The analyses of error presented herein quantify the error in a single field or laboratory value (concentration, pH, or specific conductance) and address the sources of error. Quantification of the accuracy limits of a data set is helpful in interpreting those data.

It must be remembered, however, that in any analysis of data, the propagation of the original errors through the calculations must be considered. In many cases (for example, in the calculation of a mean value or in regression analysis) an "averaging" effect is achieved which reduces the error in the final answer. Thus, error properties must be considered on a case-by-case basis. For this reason, confidence limits, hypothesis tests, standard errors, etc., are presented as applicable to characterize the uncertainties in specific analyses discussed in this report.

Many of the error measures are presented in connection with the statistical modeling study reported in Appendix G. It is notable that the data were found to be adequate for the purposes of that study (note, however, the exceptions regarding fractional attenuation below). Specifically, the "noise" level was sufficiently small to allow trends in both the leaching and fractional attenuation data to be observed; it was possible to develop polynomial regression models for laboratory leaching data, and for fractional attenuation for the cases which were selected. Trends were also clearly visible in data plots. If the data had been excessively noisy, the trends could not have been modeled successfully. Moreover, statistically significant differences between laboratory and field leaching trends were determined in most cases; i.e., the accuracy of the data was sufficiently good that differences could be discerned. These statistically significant differences are reasonable in view of the physical differences between the laboratory and field systems.

Furthermore, the analyses discussed above involved the simultaneous use of data from replicate field cells (1 and 2; 14 and 15). The data from the replicate cells were sufficiently similar to be used together in hypothesis (of differences between laboratory and field leaching trends through general linear models analysis) and model development (for field fractional attenuation data).

As is discussed in Appendix G, the fractional attenuation data are noisy in some cases. However, the standard errors (standard deviations of the scatter about the regression lines) were less than 0.3 in most of the cases investigated. Further discussion of the random scatter of fractional attenuation is presented in Appendix G.

The primary conclusion of this appendix is that, while the individual data are subject to random experimental error as quantified in this appendix, the data are sufficiently accurate to support a wide variety of analyses.

H.7 References

H-1. Searle, S.R., 1971, Linear Models, John Wiley and Sons, Inc., New York.

H-2. Wine, R. Lowell, 1964, Statistics for Scientists and Engineers, Prentice-Hall, Inc., Englewood Cliffs, N.J.

Appendix H

Attachment 1

Table H-12

Preceding page blank

Preceding page blank

TABLE H-12. UNCERTAINTIES FOR LABORATORY DATA: LEACHING DATA FOR EXXON PFBC WASTE

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
ICPES								
		1	AL	.10 TO 1.0	5	.253	.170	.530
		2	AL	.10 TO 1.0	3	.346	.214	1.01
		2	AL	1.0 TO 10.0	3	.279	.173	.816
		3	AL	.10 TO 1.0	2	.0357	.0207	.158
		1	B	10.0 TO 100.0	5	2.27	1.53	4.75
		2	B	1.0 TO 10.0	5	.680	.457	1.42
		2	B	10.0 TO 100.0	1	.346	.177	5.53
		3	B	10.0 TO 100.0	2	.232	.134	1.03
		1	BA	.10 TO 1.0	5	.0318	.0214	.0664
		2	BA	.01 TO .10	4	.00466	.00303	.0111
		2	BA	.10 TO 1.0	2	.0234	.0135	.103
		3	BA	.10 TO 1.0	2	.0193	.0112	.0854
		1	CA	1000 TO 10000	5	181	121	377
		2	CA	100 TO 1000	4	40.4	26.2	95.9
		2	CA	1000 TO 10000	2	253	146	1120
		3	CA	1000 TO 10000	2	15.6	9.00	68.8
		2	CR	.01 TO .10	1	.0101	.00516	.161
		2	CR	.10 TO 1.0	1	.135	.0688	2.15
		3	CR	.10 TO 1.0	2	.113	.0654	.500
		1	FE	.10 TO 1.0	5	.0978	.0657	.204
		2	FE	.01 TO .10	3	.0272	.0169	.0796
		2	FE	.10 TO 1.0	3	.121	.0750	.353
		3	FE	.10 TO 1.0	2	.0211	.0122	.0931
		1	MG	1.0 TO 10.0	5	2.23	1.50	4.66
		2	MG	.10 TO 1.0	5	.225	.151	.471
		2	MG	1.0 TO 10.0	1	3.44	1.76	54.9
		3	MG	.10 TO 1.0	1	.119	.0606	1.89
		3	MG	1.0 TO 10.0	1	.561	.286	8.95
		1	NA	10.0 TO 100.0	5	9.70	6.52	20.3
		2	NA	10.0 TO 100.0	2	3.69	2.13	16.3

TABLE H-12. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
		3	NA	10.0 TO 100.0	2	3.05	1.76	13.5
		1	SI	.10 TO 1.0	5	.302	.203	.631
		2	SI	.10 TO 1.0	2	.255	.147	1.12
		2	SI	1.0 TO 10.0	4	.131	.0848	.310
		3	SI	.10 TO 1.0	2	.168	.0972	.743
		1	SR	1.0 TO 10.0	5	1.07	.719	2.24
		2	SR	.10 TO 1.0	4	.0387	.0251	.0917
		2	SR	1.0 TO 10.0	2	.386	.223	1.70
		3	SR	1.0 TO 10.0	2	.256	.148	1.13
		1	ZN	.10 TO 1.0	5	.0813	.0546	.170
		2	ZN	.01 TO .10	4	.00862	.00560	.0204
		2	ZN	.10 TO 1.0	1	.0907	.0463	1.45
		3	ZN	.10 TO 1.0	2	.000495	.000286	.00219
AA								
		1	LI	.01 TO .10	5	.0122	.00823	.0256
		1	SE	.01 TO .10	5	.0316	.0212	.0660
WET CHEMISTRY								
		1	COND	1000 TO 10000	5	81.6	54.9	171
		2	COND	1000 TO 10000	7	72.6	51.2	130
		3	COND	1000 TO 10000	2	0	0	0
		1	CL	1.0 TO 10.0	5	2.05	1.37	4.27
		2	CL	1.0 TO 10.0	3	.235	.145	.685
		3	CL	10.0 TO 100.0	1	.707	.361	11.3
		1	F	.10 TO 1.0	5	.0842	.0566	.176
		2	F	.10 TO 1.0	6	.123	.0850	.236
		3	F	.10 TO 1.0	1	.0354	.0180	.564
		3	F	1.0 TO 10.0	1	2.06	1.05	32.8
		1	PH	10.0 TO 100.0	5	.208	.140	.434
		2	PH	10.0 TO 100.0	7	.0404	.0285	.0725
		3	PH	10.0 TO 100.0	2	.167	.0965	.738

TABLE H-12. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
		1	SO4	1000 TO 10000	5	22.5	15.1	47.0
		2	SO4	1000 TO 10000	7	50.9	35.9	91.5
		3	SO4	1000 TO 10000	2	62.6	36.2	277
		1	TDS	1000 TO 10000	5	774	520	1620
		2	TDS	1000 TO 10000	7	115	81.1	207
		3	TDS	1000 TO 10000	2	380	219	1680

Appendix H

Attachment 2

Table H-13

Preceding page blank

Preceding page blank

TABLE H-13. UNCERTAINTIES FOR LABORATORY DATA: ATTENUATION DATA FOR EXXON PFBC WASTE

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
ICPES								
	SHALE	5	AG	.01 TO .10	4	.0288	.0187	.0682
	SHALE	5	AG	.10 TO 1.0	2	.0305	.0177	.135
	SHALE	6	AG	.01 TO .10	2	.0876	.0506	.387
	SHALE	6	AG	.10 TO 1.0	2	.0834	.0482	.368
	SHALE	5	AL	.10 TO 1.0	4	.313	.203	.742
	SHALE	5	AL	1.0 TO 10.0	2	.206	.119	.908
	SHALE	6	AL	.10 TO 1.0	4	.375	.244	.890
	SHALE	6	AL	1.0 TO 10.0	1	.346	.176	5.51
	SHALE	4	B	.10 TO 1.0	3	.646	.401	1.89
	SHALE	5	B	.10 TO 1.0	4	.184	.119	.436
	SHALE	5	B	1.0 TO 10.0	2	.0328	.0189	.145
	SHALE	6	B	.10 TO 1.0	5	.197	.133	.412
	SHALE	4	BA	.10 TO 1.0	3	.297	.184	.867
	SHALE	5	BA	.10 TO 1.0	6	.0446	.0308	.0854
	SHALE	6	BA	.01 TO .10	5	.0608	.0409	.127
	SHALE	4	BE	.001 TO .01	1	.00354	.00180	.0564
	SHALE	6	BE	.001 TO .01	3	.00332	.00205	.00968
	SHALE	4	CA	100 TO 1000	3	235	146	687
	SHALE	5	CA	100 TO 1000	3	25.0	15.5	73.1
	SHALE	5	CA	1000 TO 10000	3	19.0	11.8	55.4
	SHALE	6	CA	100 TO 1000	5	32.3	21.7	67.5
	SHALE	6	CD	.01 TO .10	2	.0197	.0114	.0871
	SHALE	5	CO	.10 TO 1.0	3	.485	.280	2.14
	SHALE	5	CO	1.0 TO 10.0	4	.422	.274	1.00
	SHALE	6	CO	.01 TO .10	4	.0387	.0251	.0917
	SHALE	5	CR	.01 TO .10	4	.0212	.0137	.0502
	SHALE	5	CR	.10 TO 1.0	2	.0150	.00865	.0661
	SHALE	6	CR	.01 TO .10	4	.0588	.0382	.140
	SHALE	6	CR	.10 TO 1.0	1	.0643	.0328	1.03
	SHALE	4	CU	.10 TO 1.0	3	.304	.188	.888

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SHALE	5	CU	.01 TO .10	5	.0278	.0187	.0581
	SHALE	5	CU	.10 TO 1.0	1	.0173	.03884	.276
	SHALE	6	CU	.01 TO .10	5	.0534	.0359	.112
	SHALE	4	FE	.10 TO 1.0	3	.388	.240	1.13
	SHALE	5	FE	.01 TO .10	4	.0132	.00855	.0312
	SHALE	5	FE	.10 TO 1.0	2	.110	.0638	.487
	SHALE	6	FE	.01 TO .10	3	.0242	.0150	.0706
	SHALE	6	FE	.10 TO 1.0	2	.146	.0844	.645
	SHALE	5	K	100 TO 1000	6	110	75.7	210
	SHALE	6	K	10.0 TO 100.0	5	2.27	1.53	4.75
	SHALE	4	LI	.01 TO .10	1	.0339	.0173	.541
	SHALE	6	LI	.01 TO .10	5	.0327	.0220	.0683
	SHALE	4	MG	.01 TO .10	1	.0549	.0280	.876
	SHALE	5	MG	.001 TO .01	3	.00146	.000906	.00427
	SHALE	5	MG	.01 TO .10	2	.00683	.00395	.0302
	SHALE	4	MN	.10 TO 1.0	3	.366	.227	1.07
	SHALE	5	MN	.001 TO .01	2	.00198	.00114	.00873
	SHALE	5	MN	.01 TO .10	4	.00501	.00326	.0119
	SHALE	6	MN	.01 TO .10	1	.00283	.00144	.0451
	SHALE	6	MN	.10 TO 1.0	1	.0665	.0339	1.06
	SHALE	6	MN	1.0 TO 10.0	3	.0564	.0350	.165
	SHALE	5	MO	1.0 TO 10.0	6	.310	.214	.593
	SHALE	6	MO	.10 TO 1.0	5	.0455	.0306	.0951
	SHALE	5	NA	10.0 TO 100.0	2	2.15	1.24	9.49
	SHALE	6	NA	10.0 TO 100.0	5	1.54	1.04	3.22
	SHALE	4	NI	.10 TO 1.0	3	.287	.178	.839
	SHALE	5	NI	.10 TO 1.0	6	.0377	.0260	.0722
	SHALE	6	NI	.01 TO .10	3	.0245	.0152	.0716
	SHALE	4	SI	1.0 TO 10.0	3	1.40	.865	4.08
	SHALE	5	SI	.10 TO 1.0	4	.121	.0786	.287
	SHALE	5	SI	1.0 TO 10.0	2	.289	.167	1.28
	SHALE	6	SI	1.0 TO 10.0	5	.180	.121	.377
	SHALE	4	SR	1.0 TO 10.0	3	.527	.327	1.54
	SHALE	5	SR	1.0 TO 10.0	6	.138	.0950	.264

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SHALE	6	SR	.10 TO 1.0	5	.0645	.0434	.135
	SHALE	4	TI	.10 TO 1.0	3	.279	.173	.815
	SHALE	5	TI	.01 TO .10	4	.0106	.00691	.0253
	SHALE	5	TI	.10 TO 1.0	2	.0209	.0121	.0922
	SHALE	6	TI	.01 TO .10	1	.120	.0613	1.92
	SHALE	6	TI	.10 TO 1.0	4	.149	.0968	.354
	SHALE	4	V	.10 TO 1.0	3	.263	.163	.768
	SHALE	5	V	.01 TO .10	4	.0365	.0237	.0865
	SHALE	5	V	.10 TO 1.0	2	.0517	.0299	.228
	SHALE	6	V	.01 TO .10	1	.0933	.0476	1.49
	SHALE	6	V	.10 TO 1.0	4	.113	.0737	.269
	SHALE	5	ZN	.001 TO .01	2	.00486	.00281	.0215
	SHALE	5	ZN	.01 TO .10	3	.00485	.00300	.0141
	SHALE	6	ZN	.01 TO .10	5	.0204	.0137	.0425
	INTERBURDEN	5	AG	.01 TO .10	2	.0210	.0121	.0928
	INTERBURDEN	5	AG	.10 TO 1.0	4	.0656	.0426	.156
	INTERBURDEN	6	AG	.10 TO 1.0	5	.174	.117	.363
	INTERBURDEN	4	AL	.10 TO 1.0	3	.121	.0750	.353
	INTERBURDEN	5	AL	.10 TO 1.0	3	.183	.113	.535
	INTERBURDEN	5	AL	1.0 TO 10.0	3	.717	.444	2.09
	INTERBURDEN	6	AL	1.0 TO 10.0	5	.425	.285	.887
	INTERBURDEN	5	B	1.0 TO 10.0	6	.325	.224	.623
	INTERBURDEN	6	B	.10 TO 1.0	4	.0734	.0477	.174
	INTERBURDEN	6	B	1.0 TO 10.0	1	.0849	.0433	1.35
	INTERBURDEN	4	BA	.10 TO 1.0	3	.0979	.0606	.286
	INTERBURDEN	5	BA	.10 TO 1.0	6	.0408	.0282	.0782
	INTERBURDEN	6	BA	.01 TO .10	1	.00941	.00480	.150
	INTERBURDEN	6	BA	.10 TO 1.0	4	.0263	.0171	.0625
	INTERBURDEN	4	CA	1000 TO 10000	3	283	175	825
	INTERBURDEN	5	CA	100 TO 1000	3	98.2	60.9	287
	INTERBURDEN	5	CA	1000 TO 10000	3	10.8	6.70	31.6
	INTERBURDEN	6	CA	100 TO 1000	5	10[illegible]	70.6	220
	INTERBURDEN	6	CD	.01 TO .10	3	.0163	.0101	.0477
	INTERBURDEN	6	CD	.10 TO 1.0	2	.106	.0612	.468

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	INTERBURDEN	5	CO	.10 TO 1.0	2	.307	.177	1.36
	INTERBURDEN	5	CO	1.0 TO 10.0	4	1.07	.696	2.54
	INTERBURDEN	6	CO	1.0 TO 10.0	5	2.42	1.63	5.06
	INTERBURDEN	5	CR	.01 TO .10	3	.0113	.00700	.0330
	INTERBURDEN	5	CR	.10 TO 1.0	3	.0534	.0331	.156
	INTERBURDEN	6	CR	.10 TO 1.0	5	.115	.0770	.239
	INTERBURDEN	5	CU	.01 TO .10	3	.0171	.0106	.0500
	INTERBURDEN	5	CU	.10 TO 1.0	3	.0729	.0452	.213
	INTERBURDEN	6	CU	.10 TO 1.0	3	.0250	.0155	.0730
	INTERBURDEN	6	CU	1.0 TO 10.0	2	.237	.137	1.05
	INTERBURDEN	4	FE	.01 TO .10	3	.0520	.0322	.152
	INTERBURDEN	5	FE	.01 TO .10	6	.0307	.0212	.0587
	INTERBURDEN	6	FE	.10 TO 1.0	2	.0970	.0560	.428
	INTERBURDEN	6	FE	1.0 TO 10.0	2	2.93	1.69	12.9
	INTERBURDEN	6	FE	10.0 TO 100.0	1	.0778	.0397	1.24
	INTERBURDEN	5	K	100 TO 1000	6	211	146	404
	INTERBURDEN	6	K	100 TO 1000	3	118	73.0	344
	INTERBURDEN	6	K	1000 TO 10000	2	1070	620	4740
	INTERBURDEN	4	MG	.01 TO .10	3	.0290	.0180	.0848
	INTERBURDEN	5	MG	.001 TO .01	2	7.7E-05	4.4E-05	.000340
	INTERBURDEN	5	MG	.01 TO .10	2	.00248	.00143	.0109
	INTERBURDEN	6	MG	.01 TO .10	1	.0248	.0127	.396
	INTERBURDEN	6	MG	1.0 TO 10.0	3	2.90	1.80	8.48
	INTERBURDEN	6	MG	100 TO 1000	1	.849	.433	13.5
	INTERBURDEN	5	MN	.001 TO .01	2	.00224	.00129	.00988
	INTERBURDEN	5	MN	.01 TO .10	4	.00726	.00471	.0172
	INTERBURDEN	6	MN	.01 TO .10	1	.000339	.000173	.00541
	INTERBURDEN	6	MN	.10 TO 1.0	1	.0342	.0174	.545
	INTERBURDEN	6	MN	1.0 TO 10.0	3	.550	.341	1.61
	INTERBURDEN	4	MO	1.0 TO 10.0	1	.139	.0707	2.21
	INTERBURDEN	5	MO	1.0 TO 10.0	6	.585	.404	1.12
	INTERBURDEN	6	MO	1.0 TO 10.0	5	2.11	1.42	4.40
	INTERBURDEN	5	NA	10.0 TO 100.0	2	.969	.560	4.28
	INTERBURDEN	6	NA	1.0 TO 10.0	1	.0240	.0123	.383

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	INTERBURDEN	6	NA	10.0 TO 100.0	2	.440	.254	1.94
	INTERBURDEN	5	NI	.10 TO 1.0	6	.0695	.0480	.133
	INTERBURDEN	6	NI	.10 TO 1.0	1	.000495	.000253	.00789
	INTERBURDEN	6	NI	1.0 TO 10.0	4	.694	.450	1.65
	INTERBURDEN	4	SI	1.0 TO 10.0	3	.235	.146	.488
	INTERBURDEN	5	SI	.10 TO 1.0	4	.219	.142	.519
	INTERBURDEN	5	SI	1.0 TO 10.0	2	.131	.0757	.579
	INTERBURDEN	6	SI	1.0 TO 10.0	2	.460	.266	2.03
	INTERBURDEN	6	SI	10.0 TO 100.0	3	13.2	8.20	38.7
	INTERBURDEN	4	SR	1.0 TO 10.0	3	.522	.323	1.52
	INTERBURDEN	5	SR	1.0 TO 10.0	6	.272	.188	.521
	INTERBURDEN	6	SR	.10 TO 1.0	1	.0821	.0419	1.31
	INTERBURDEN	6	SR	1.0 TO 10.0	4	.593	.385	1.41
	INTERBURDEN	5	TI	.01 TO .10	4	.0226	.0147	.0536
	INTERBURDEN	5	TI	.10 TO 1.0	2	.00876	.00506	.0387
	INTERBURDEN	6	TI	.01 TO .10	2	.0121	.00700	.0535
	INTERBURDEN	6	TI	.10 TO 1.0	3	.0725	.0449	.212
	INTERBURDEN	5	V	.01 TO .10	2	.0241	.0139	.107
	INTERBURDEN	5	V	.10 TO 1.0	4	.0816	.0530	.194
	INTERBURDEN	6	V	.10 TO 1.0	5	.171	.115	.358
	INTERBURDEN	5	ZN	.001 TO .01	1	.000312	.000159	.00497
	INTERBURDEN	5	ZN	.01 TO .10	5	.0113	.00757	.0235
	INTERBURDEN	6	ZN	.01 TO .10	1	.00230	.00117	.0366
	INTERBURDEN	6	ZN	.10 TO 1.0	1	.0564	.0288	.900
	INTERBURDEN	6	ZN	1.0 TO 10.0	3	1.36	.840	3.96
	SANDSTONE	4	AG	.01 TO .10	3	.0128	.00790	.0372
	SANDSTONE	5	AG	.01 TO .10	1	1.3E-09	6.7E-10	2.1E-08
	SANDSTONE	5	AG	.10 TO 1.0	5	.0653	.0439	.136
	SANDSTONE	6	AG	.001 TO .01	1	.00495	.00253	.0789
	SANDSTONE	6	AG	.01 TO .10	3	.0188	.0117	.0550
	SANDSTONE	4	AL	.10 TO 1.0	3	.185	.114	.539
	SANDSTONE	5	AL	.10 TO 1.0	1	.0378	.0193	.602
	SANDSTONE	5	AL	1.0 TO 10.0	5	.576	.387	1.20
	SANDSTONE	6	AL	.10 TO 1.0	5	.148	.0996	.310

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SANDSTONE	4	B	.10 TO 1.0	3	.258	.160	.752
	SANDSTONE	5	B	.10 TO 1.0	3	.214	.133	.626
	SANDSTONE	5	B	1.0 TO 10.0	3	.155	.0963	.454
	SANDSTONE	6	B	.10 TO 1.0	5	.151	.101	.315
	SANDSTONE	4	BA	.10 TO 1.0	3	.0626	.0388	.183
	SANDSTONE	5	BA	.10 TO 1.0	6	.0333	.0230	.0638
	SANDSTONE	6	BA	.01 TO .10	5	.0676	.0455	.141
	SANDSTONE	4	BE	.001 TO .01	1	5.8E-11	3.0E-11	9.3E-10
	SANDSTONE	6	BE	.001 TO .01	2	.000500	.000289	.00221
	SANDSTONE	4	CA	100 TO 1000	3	43.4	26.9	127
	SANDSTONE	5	CA	100 TO 1000	4	159	103	377
	SANDSTONE	5	CA	1000 TO 10000	2	5.15	2.97	22.7
	SANDSTONE	6	CA	100 TO 1000	5	21.0	14.1	43.9
	SANDSTONE	4	CO	.10 TO 1.0	3	.602	.373	1.76
	SANDSTONE	5	CO	1.0 TO 10.0	6	.984	.680	1.89
	SANDSTONE	6	CO	.01 TO .10	3	.00827	.00512	.0241
	SANDSTONE	4	CR	.01 TO .10	3	.00820	.00508	.0239
	SANDSTONE	5	CR	.01 TO .10	4	.0354	.0230	.0840
	SANDSTONE	5	CR	.10 TO 1.0	2	.0520	.0306	.238
	SANDSTONE	6	CR	.01 TO .10	4	.00919	.00597	.0218
	SANDSTONE	4	CU	.01 TO .10	3	.0167	.0104	.0488
	SANDSTONE	5	CU	.01 TO .10	1	.000212	.000108	.00338
	SANDSTONE	5	CU	.10 TO 1.0	5	.0626	.0421	.131
	SANDSTONE	6	CU	.001 TO .01	1	.00566	.00289	.0902
	SANDSTONE	6	CU	.01 TO .10	3	.0111	.00688	.0324
	SANDSTONE	4	FE	.10 TO 1.0	3	.447	.277	1.30
	SANDSTONE	5	FE	.01 TO .10	2	.0409	.0236	.181
	SANDSTONE	5	FE	.10 TO 1.0	4	.122	.0791	.289
	SANDSTONE	6	FE	.01 TO .10	1	.0325	.0166	.519
	SANDSTONE	6	FE	.10 TO 1.0	3	.227	.141	.662
	SANDSTONE	4	K	100 TO 1000	3	224	139	653
	SANDSTONE	5	K	100 TO 1000	5	244	164	509
	SANDSTONE	5	K	1000 TO 10000	1	45.0	23.0	718
	SANDSTONE	6	K	10.0 TO 100.0	5	7.47	5.02	15.6

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SANDSTONE	4	LI	.01 TO .10	1	.00283	.00144	.0451
	SANDSTONE	6	LI	.001 TO .01	1	.00707	.00361	.113
	SANDSTONE	6	LI	.01 TO .10	4	.00897	.00583	.0213
	SANDSTONE	4	MG	.001 TO .01	1	.000273	.000139	.00435
	SANDSTONE	5	MG	.001 TO .01	2	.00263	.00152	.0116
	SANDSTONE	5	MG	.01 TO .10	2	.00452	.00261	.0200
	SANDSTONE	4	MN	.01 TO .10	3	.00581	.00360	.0170
	SANDSTONE	5	MN	.01 TO .10	6	.00690	.00476	.0132
	SANDSTONE	6	MN	.01 TO .10	1	.00354	.00180	.0564
	SANDSTONE	6	MN	.10 TO 1.0	2	.0359	.0208	.159
	SANDSTONE	6	MN	1.0 TO 10.0	2	.0486	.0281	.215
	SANDSTONE	4	MO	1.0 TO 10.0	3	.455	.282	1.33
	SANDSTONE	5	MO	1.0 TO 10.0	6	.610	.421	1.17
	SANDSTONE	6	MO	.10 TO 1.0	5	.0279	.0188	.0584
	SANDSTONE	5	NA	10.0 TO 100.0	2	.918	.530	4.05
	SANDSTONE	6	NA	10.0 TO 100.0	5	2.61	1.76	5.46
	SANDSTONE	5	NI	.10 TO 1.0	6	.0758	.0523	.145
	SANDSTONE	6	NI	.01 TO .10	3	.0257	.0160	.0752
	SANDSTONE	4	SI	.10 TO 1.0	3	.330	.204	.963
	SANDSTONE	5	SI	.10 TO 1.0	4	.219	.142	.519
	SANDSTONE	5	SI	1.0 TO 10.0	2	.0880	.0508	.389
	SANDSTONE	6	SI	1.0 TO 10.0	5	.207	.139	.432
	SANDSTONE	4	SR	1.0 TO 10.0	3	.285	.177	.833
	SANDSTONE	5	SR	1.0 TO 10.0	6	.399	.276	.765
	SANDSTONE	6	SR	1.0 TO 10.0	5	.146	.0983	.306
	SANDSTONE	4	TI	.01 TO .10	3	.0357	.0221	.104
	SANDSTONE	5	TI	.01 TO .10	4	.0231	.0150	.0549
	SANDSTONE	5	TI	.10 TO 1.0	2	.0145	.00837	.0640
	SANDSTONE	6	TI	.01 TO .10	4	.0282	.0183	.0668
	SANDSTONE	4	V	.01 TO .10	3	.0122	.00758	.0357
	SANDSTONE	5	V	.01 TO .10	1	.00163	.000833	.0260
	SANDSTONE	5	V	.10 TO 1.0	5	.0812	.0546	.170
	SANDSTONE	6	V	.01 TO .10	4	.0240	.0156	.0570
	SANDSTONE	4	ZN	.01 TO .10	3	.00455	.00282	.0133

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SANDSTONE	5	ZN	.001 TO .01	1	.00238	.00122	.0380
	SANDSTONE	5	ZN	.01 TO .10	5	.0116	.00777	.0242
	SANDSTONE	6	ZN	.001 TO .01	1	.00424	.00216	.0677
	SANDSTONE	6	ZN	.01 TO .10	3	.00451	.00279	.0132
	GREER LIMESTONE	4	AL	.10 TO 1.0	1	.0862	.0450	1.41
	GREER LIMESTONE	6	AL	.10 TO 1.0	1	.0419	.0214	.668
	GREER LIMESTONE	4	B	1.0 TO 10.0	1	.603	.308	9.62
	GREER LIMESTONE	4	BA	.01 TO .10	1	.00736	.00376	.117
	GREER LIMESTONE	6	BA	.01 TO .10	1	.0162	.00825	.258
	GREER LIMESTONE	4	CA	1000 TO 10000	1	233	119	3710
	GREER LIMESTONE	6	CA	1000 TO 10000	1	117	59.5	1860
	GREER LIMESTONE	4	FE	.10 TO 1.0	1	.0810	.0413	1.29
	GREER LIMESTONE	6	FE	.10 TO 1.0	1	.0190	.00967	.302
	GREER LIMESTONE	4	MG	.10 TO 1.0	1	.109	.0557	1.74
	GREER LIMESTONE	6	MG	.01 TO .10	1	.00110	.000559	.0175
	GREER LIMESTONE	4	NA	10.0 TO 100.0	1	13.6	6.96	218
	GREER LIMESTONE	6	NA	10.0 TO 100.0	1	14.3	7.32	229
	GREER LIMESTONE	4	SI	1.0 TO 10.0	1	.645	.329	10.3
	GREER LIMESTONE	6	SI	1.0 TO 10.0	1	.317	.162	5.06
	GREER LIMESTONE	4	SR	1.0 TO 10.0	1	.556	.284	8.86
	GREER LIMESTONE	6	SR	1.0 TO 10.0	1	1.67	.854	26.7
	GREER LIMESTONE	4	ZN	.10 TO 1.0	1	.129	.0658	2.06
	GREER LIMESTONE	6	ZN	.10 TO 1.0	1	.140	.0715	2.23
	GLACIAL TILL	5	AG	.01 TO .10	3	.0154	.00957	.0451
	GLACIAL TILL	5	AG	.10 TO 1.0	3	.0444	.0275	.130
	GLACIAL TILL	4	AL	.10 TO 1.0	3	.205	.127	.598
	GLACIAL TILL	5	AL	.10 TO 1.0	3	.158	.0982	.463
	GLACIAL TILL	5	AL	1.0 TO 10.0	3	.386	.239	1.13
	GLACIAL TILL	6	AL	.10 TO 1.0	5	.202	.136	.421
	GLACIAL TILL	4	B	.10 TO 1.0	3	.292	.181	.852
	GLACIAL TILL	5	B	1.0 TO 10.0	6	.197	.136	.378
	GLACIAL TILL	6	B	.10 TO 1.0	5	.0481	.0323	.100
	GLACIAL TILL	4	BA	.10 TO 1.0	3	.0653	.0405	.191
	GLACIAL TILL	5	BA	.10 TO 1.0	6	.0311	.0215	.0596

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	GLACIAL TILL	6	BA	.01 TO .10	1	.00778	.00397	.124
	GLACIAL TILL	6	BA	.10 TO 1.0	4	.0293	.0190	.0695
	GLACIAL TILL	4	CA	100 TO 1000	3	63.9	39.6	187
	GLACIAL TILL	5	CA	100 TO 1000	5	59.7	40.1	125
	GLACIAL TILL	5	CA	1000 TO 10000	1	43.3	22.1	691
	GLACIAL TILL	6	CA	100 TO 1000	5	7.57	5.08	15.8
	GLACIAL TILL	5	CO	.10 TO 1.0	3	.229	.142	.670
	GLACIAL TILL	5	CO	1.0 TO 10.0	3	.729	.452	2.13
	GLACIAL TILL	4	CR	.01 TO .10	3	.0226	.0140	.0659
	GLACIAL TILL	5	CR	.01 TO .10	3	.0106	.00658	.0310
	GLACIAL TILL	5	CR	.10 TO 1.0	3	.0286	.0177	.0834
	GLACIAL TILL	6	CR	.01 TO .10	5	.0132	.00885	.0275
	GLACIAL TILL	4	CU	.01 TO .10	3	.0408	.0253	.119
	GLACIAL TILL	5	CU	.01 TO .10	3	.0123	.00759	.0358
	GLACIAL TILL	5	CU	.10 TO 1.0	3	.0382	.0237	.112
	GLACIAL TILL	4	FE	.10 TO 1.0	3	.509	.315	1.48
	GLACIAL TILL	5	FE	.01 TO .10	2	.0346	.0200	.153
	GLACIAL TILL	5	FE	.10 TO 1.0	4	.0374	.0243	.0888
	GLACIAL TILL	6	FE	.10 TO 1.0	4	.269	.175	.638
	GLACIAL TILL	4	K	100 TO 1000	3	240	149	702
	GLACIAL TILL	5	K	100 TO 1000	6	123	85.2	236
	GLACIAL TILL	6	K	1.0 TO 10.0	4	.272	.177	.646
	GLACIAL TILL	6	K	10.0 TO 100.0	1	.0990	.0505	1.58
	GLACIAL TILL	4	MG	.001 TO .01	1	.00212	.00108	.0338
	GLACIAL TILL	5	MG	.001 TO .01	4	.00212	.00138	.00503
	GLACIAL TILL	5	MG	.01 TO .10	2	.0273	.0158	.120
	GLACIAL TILL	4	MN	.01 TO .10	3	.00451	.00280	.0132
	GLACIAL TILL	5	MN	.001 TO .01	3	.00202	.00125	.00589
	GLACIAL TILL	5	MN	.01 TO .10	3	.00505	.00313	.0147
	GLACIAL TILL	6	MN	.001 TO .01	1	.000707	.000361	.0113
	GLACIAL TILL	6	MN	.01 TO .10	4	.00337	.00219	.00800
	GLACIAL TILL	4	MO	1.0 TO 10.0	3	.548	.340	1.60
	GLACIAL TILL	5	MO	1.0 TO 10.0	6	.343	.237	.656
	GLACIAL TILL	6	MO	.01 TO .10	2	.00851	.00492	.0376

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	GLACIAL TILL	6	MO	.10 TO 1.0	3	.0127	.00785	.0370
	GLACIAL TILL	5	NA	10.0 TO 100.0	2	.929	.536	4.10
	GLACIAL TILL	6	NA	10.0 TO 100.0	5	1.62	1.09	3.39
	GLACIAL TILL	5	NI	.10 TO 1.0	6	.0399	.0276	.0765
	GLACIAL TILL	4	SI	1.0 TO 10.0	3	.511	.316	1.49
	GLACIAL TILL	5	SI	.10 TO 1.0	4	.124	.0804	.294
	GLACIAL TILL	5	SI	1.0 TO 10.0	2	.116	.0671	.513
	GLACIAL TILL	6	SI	1.0 TO 10.0	5	.337	.226	.704
	GLACIAL TILL	4	SR	.10 TO 1.0	3	.135	.0839	.395
	GLACIAL TILL	5	SR	1.0 TO 10.0	6	.225	.156	.432
	GLACIAL TILL	6	SR	.10 TO 1.0	5	.0125	.00840	.0261
	GLACIAL TILL	5	TI	.01 TO .10	4	.0121	.00786	.0287
	GLACIAL TILL	5	TI	.10 TO 1.0	2	.00290	.00167	.0128
	GLACIAL TILL	5	V	.01 TO .10	3	.0154	.00954	.0450
	GLACIAL TILL	5	V	.10 TO 1.0	3	.0571	.0354	.167
	GLACIAL TILL	5	ZN	.001 TO .01	2	.00363	.00210	.0160
	GLACIAL TILL	5	ZN	.01 TO .10	3	.0104	.00645	.0304
	GLACIAL TILL	6	ZN	.01 TO .10	3	.00385	.00239	.0112
	ALLUVIUM	4	AG	.01 TO .10	3	.0530	.0328	.155
	ALLUVIUM	5	AG	.01 TO .10	2	.0470	.0271	.207
	ALLUVIUM	5	AS	.10 TO 1.0	4	.0555	.0360	.132
	ALLUVIUM	4	AL	.10 TO 1.0	3	.340	.211	.993
	ALLUVIUM	5	AL	.10 TO 1.0	2	.384	.222	1.69
	ALLUVIUM	5	AL	1.0 TO 10.0	4	.481	.312	1.14
	ALLUVIUM	6	AL	.10 TO 1.0	4	.152	.0984	.359
	ALLUVIUM	6	AL	1.0 TO 10.0	1	.453	.231	7.23
	ALLUVIUM	4	B	.10 TO 1.0	3	.156	.0968	.456
	ALLUVIUM	5	B	.10 TO 1.0	1	.0926	.0472	1.48
	ALLUVIUM	5	B	1.0 TO 10.0	5	.169	.113	.352
	ALLUVIUM	6	B	.10 TO 1.0	5	.189	.127	.395
	ALLUVIUM	4	BA	.10 TO 1.0	3	.0546	.0338	.159
	ALLUVIUM	5	BA	.10 TO 1.0	6	.0418	.0298	.0800
	ALLUVIUM	6	BA	.10 TO 1.0	5	.0170	.0114	.0355
	ALLUVIUM	4	CA	100 TO 1000	3	20.0	12.4	58.5

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	ALLUVIUM	5	CA	100 TO 1000	3	56.2	34.8	164
	ALLUVIUM	5	CA	1000 TO 10000	3	27.5	17.1	80.4
	ALLUVIUM	6	CA	100 TO 1000	5	5.18	3.48	10.8
	ALLUVIUM	5	CD	.01 TO .10	1	.0449	.0229	.715
	ALLUVIUM	5	CD	.10 TO 1.0	1	.0310	.0158	.494
	ALLUVIUM	5	CD	1.0 TO 10.0	6	.859	.593	1.65
	ALLUVIUM	6	CD	.001 TO .01	1	.00283	.00144	.0451
	ALLUVIUM	4	CR	.01 TO .10	3	.0330	.0205	.0964
	ALLUVIUM	5	CR	.01 TO .10	1	.0104	.00528	.165
	ALLUVIUM	5	CR	.10 TO 1.0	5	.0369	.0248	.0771
	ALLUVIUM	6	CR	.001 TO .01	3	.00498	.00309	.0146
	ALLUVIUM	6	CR	.01 TO .10	1	.00354	.00180	.0564
	ALLUVIUM	4	CU	.01 TO .10	3	.0502	.0311	.147
	ALLUVIUM	5	CU	.01 TO .10	2	.0440	.0254	.194
	ALLUVIUM	5	CU	.10 TO 1.0	4	.0519	.0337	.123
	ALLUVIUM	6	CU	.001 TO .01	1	.000707	.000361	.0113
	ALLUVIUM	6	CU	.01 TO .10	1	.00212	.00108	.0338
	ALLUVIUM	4	FE	.10 TO 1.0	3	.229	.142	.670
	ALLUVIUM	5	FE	.10 TO 1.0	6	.111	.0763	.212
	ALLUVIUM	6	FE	.01 TO .10	1	.0198	.0101	.316
	ALLUVIUM	6	FE	.10 TO 1.0	3	.327	.202	.954
	ALLUVIUM	6	FE	1.0 TO 10.0	1	.703	.359	11.2
	ALLUVIUM	4	K	100 TO 1000	3	280	173	817
	ALLUVIUM	5	K	100 TO 1000	4	128	83.4	305
	ALLUVIUM	5	K	1000 TO 10000	2	296	171	1310
	ALLUVIUM	6	K	10.0 TO 100.0	5	.462	.311	.966
	ALLUVIUM	5	MG	.001 TO .01	4	.000918	.000596	.00218
	ALLUVIUM	5	MG	.01 TO .10	2	.0269	.0155	.119
	ALLUVIUM	4	MN	.01 TO .10	3	.00437	.00271	.0128
	ALLUVIUM	5	MN	.01 TO .10	5	.00616	.00425	.0118
	ALLUVIUM	6	MN	.01 TO .10	1	.0311	.0159	.496
	ALLUVIUM	6	MN	.10 TO 1.0	1	.0594	.0303	.947
	ALLUVIUM	6	MN	1.0 TO 10.0	3	.0150	.00929	.0438
	ALLUVIUM	4	MO	1.0 TO 10.0	3	.623	.386	1.82

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	ALLUVIUM	5	MO	1.0 TO 10.0	6	.580	.401	1.11
	ALLUVIUM	6	MO	.01 TO .10	1	.00849	.00433	.135
	ALLUVIUM	6	MO	.10 TO 1.0	1	.0141	.00722	.226
	ALLUVIUM	5	NA	1.0 TO 10.0	1	2.73	1.39	43.6
	ALLUVIUM	5	NA	10.0 TO 100.0	3	1.48	.918	4.33
	ALLUVIUM	6	NA	10.0 TO 100.0	5	.297	.200	.621
	ALLUVIUM	5	NI	.10 TO 1.0	6	.0655	.0452	.126
	ALLUVIUM	6	NI	.01 TO .10	3	.0100	.00620	.0292
	ALLUVIUM	4	SI	1.0 TO 10.0	3	.301	.186	.878
	ALLUVIUM	5	SI	.10 TO 1.0	2	.158	.0911	.696
	ALLUVIUM	5	SI	1.0 TO 10.0	4	.188	.122	.446
	ALLUVIUM	6	SI	1.0 TO 10.0	3	.307	.190	.896
	ALLUVIUM	6	SI	10.0 TO 100.0	2	.488	.282	2.16
	ALLUVIUM	4	SR	1.0 TO 10.0	3	.0270	.0167	.0787
	ALLUVIUM	5	SR	.10 TO 1.0	1	.118	.0602	1.88
	ALLUVIUM	5	SR	1.0 TO 10.0	5	.191	.129	.400
	ALLUVIUM	6	SR	.10 TO 1.0	5	.0204	.0137	.0426
	ALLUVIUM	4	TI	.01 TO .10	3	.0185	.0115	.0540
	ALLUVIUM	5	TI	.01 TO .10	2	.0171	.00990	.0757
	ALLUVIUM	5	TI	.10 TO 1.0	4	.0176	.0114	.0418
	ALLUVIUM	6	TI	.001 TO .01	1	.00212	.00108	.0338
	ALLUVIUM	4	V	.01 TO .10	3	.0619	.0384	.181
	ALLUVIUM	5	V	.10 TO 1.0	6	.0663	.0458	.127
	ALLUVIUM	6	V	.01 TO .10	4	.00774	.00502	.0184
	ALLUVIUM	5	ZN	.01 TO .10	6	.0115	.00791	.0219
	ALLUVIUM	6	ZN	.01 TO .10	2	.00570	.00329	.0252
	LIMESTONE	4	AG	.10 TO 1.0	3	.0402	.0249	.117
	LIMESTONE	5	AG	.10 TO 1.0	6	.0916	.0632	.175
	LIMESTONE	6	AG	.01 TO .10	3	.00805	.00499	.0235
	LIMESTONE	6	AG	.10 TO 1.0	1	.310	.158	4.94
	LIMESTONE	4	AL	1.0 TO 10.0	3	.351	.217	1.02
	LIMESTONE	5	AL	1.0 TO 10.0	6	.851	.588	1.63
	LIMESTONE	6	AL	.10 TO 1.0	3	.0292	.0181	.0853
	LIMESTONE	6	AL	1.0 TO 10.0	1	2.78	1.42	44.3

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	LIMESTONE	4	B	.10 TO 1.0	3	.0680	.0421	.199
	LIMESTONE	5	B	1.0 TO 10.0	6	.482	.333	.924
	LIMESTONE	6	B	.10 TO 1.0	3	.153	.0948	.447
	LIMESTONE	6	B	1.0 TO 10.0	1	.243	.124	3.87
	LIMESTONE	4	BA	.10 TO 1.0	3	.0258	.0160	.0753
	LIMESTONE	5	BA	.01 TO .10	1	.00356	.00182	.0568
	LIMESTONE	5	BA	.10 TO 1.0	5	.0134	.00899	.0280
	LIMESTONE	6	BA	.10 TO 1.0	4	.0340	.0221	.0806
	LIMESTONE	4	CA	100 TO 1000	3	55.1	34.2	161
	LIMESTONE	5	CA	100 TO 1000	2	245	142	1080
	LIMESTONE	5	CA	1000 TO 10000	4	99.0	64.3	235
	LIMESTONE	6	CA	100 TO 1000	4	59.1	38.4	140
	LIMESTONE	4	CD	.01 TO .10	3	.0249	.0154	.0728
	LIMESTONE	5	CD	.10 TO 1.0	1	.0394	.0201	.628
	LIMESTONE	6	CD	.01 TO .10	3	.0662	.0410	.193
	LIMESTONE	4	CO	1.0 TO 10.0	3	.683	.423	1.99
	LIMESTONE	5	CO	1.0 TO 10.0	6	1.51	1.04	2.89
	LIMESTONE	6	CO	.10 TO 1.0	3	.0737	.0457	.215
	LIMESTONE	6	CO	1.0 TO 10.0	1	5.02	2.56	80.1
	LIMESTONE	4	CR	.10 TO 1.0	3	.0323	.0200	.0944
	LIMESTONE	5	CR	.10 TO 1.0	6	.0607	.0419	.116
	LIMESTONE	6	CR	.01 TO .10	3	.00471	.00292	.0138
	LIMESTONE	6	CR	.10 TO 1.0	1	.211	.108	3.37
	LIMESTONE	4	CU	.10 TO 1.0	3	.0397	.0246	.116
	LIMESTONE	5	CU	.10 TO 1.0	6	.0880	.0607	.168
	LIMESTONE	6	CU	.01 TO .10	3	.00566	.00351	.0165
	LIMESTONE	6	CU	.10 TO 1.0	1	.292	.149	4.65
	LIMESTONE	4	FE	.01 TO .10	3	.0283	.0175	.0826
	LIMESTONE	5	FE	.01 TO .10	2	.0126	.00727	.0556
	LIMESTONE	5	FE	.10 TO 1.0	4	.0468	.0304	.111
	LIMESTONE	6	FE	.01 TO .10	2	.0225	.0130	.0993
	LIMESTONE	6	FE	.10 TO 1.0	2	.134	.0774	.592
	LIMESTONE	4	K	100 TO 1000	3	161	100	471
	LIMESTONE	5	K	100 TO 1000	4	137	88.6	324

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	LIMESTONE	5	K	1000 TO 10000	2	573	331	2530
	LIMESTONE	6	K	100 TO 1000	3	20.2	12.5	59.0
	LIMESTONE	6	K	1000 TO 10000	1	1190	607	19000
	LIMESTONE	4	MG	.001 TO .01	3	.00516	.00319	.0151
	LIMESTONE	5	MG	.001 TO .01	4	.00423	.00275	.0100
	LIMESTONE	5	MG	.01 TO .10	1	.000212	.000108	.00338
	LIMESTONE	5	MG	.10 TO 1.0	1	.0352	.0179	.561
	LIMESTONE	6	MG	.01 TO .10	1	.00426	.00218	.0680
	LIMESTONE	6	MG	1.0 TO 10.0	1	.0799	.0408	1.27
	LIMESTONE	6	MG	10.0 TO 100.0	2	.544	.314	2.40
	LIMESTONE	4	MN	.01 TO .10	3	.00520	.00322	.0152
	LIMESTONE	5	MN	.01 TO .10	6	.00986	.00681	.0189
	LIMESTONE	6	MN	.001 TO .01	1	.00130	.000662	.0207
	LIMESTONE	6	MN	.01 TO .10	3	.0207	.0128	.0605
	LIMESTONE	4	MO	1.0 TO 10.0	3	.397	.246	1.16
	LIMESTONE	5	MO	1.0 TO 10.0	6	.991	.684	1.90
	LIMESTONE	6	MO	1.0 TO 10.0	4	1.61	1.04	3.81
	LIMESTONE	4	NA	1.0 TO 10.0	3	.735	.455	2.15
	LIMESTONE	5	NA	1.0 TO 10.0	1	5.58	2.85	89.0
	LIMESTONE	5	NA	10.0 TO 100.0	3	1.42	.880	4.15
	LIMESTONE	6	NA	10.0 TO 100.0	3	1.75	1.09	5.12
	LIMESTONE	4	NI	.10 TO 1.0	3	.0478	.0296	.140
	LIMESTONE	5	NI	.10 TO 1.0	6	.115	.0795	.221
	LIMESTONE	6	NI	.01 TO .10	2	.00488	.00282	.0215
	LIMESTONE	6	NI	.10 TO 1.0	2	.296	.171	1.31
	LIMESTONE	4	SI	1.0 TO 10.0	3	.203	.126	.593
	LIMESTONE	5	SI	.10 TO 1.0	2	.153	.0886	.677
	LIMESTONE	5	SI	1.0 TO 10.0	4	.374	.243	.887
	LIMESTONE	6	SI	1.0 TO 10.0	3	.170	.105	.497
	LIMESTONE	6	SI	10.0 TO 100.0	1	.0778	.0397	1.24
	LIMESTONE	4	SR	1.0 TO 10.0	3	.504	.312	1.47
	LIMESTONE	5	SR	.10 TO 1.0	1	.159	.0811	2.53
	LIMESTONE	6	SR	1.0 TO 10.0	5	.452	.304	.945
					4	.956	.621	2.27

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	LIMESTONE	4	TI	.01 TO .10	3	.0136	.00846	.0399
	LIMESTONE	5	TI	.01 TO .10	2	.0144	.00831	.0635
	LIMESTONE	5	TI	.10 TO 1.0	4	.0363	.0236	.0861
	LIMESTONE	6	TI	.01 TO .10	4	.0530	.0344	.126
	LIMESTONE	4	V	.10 TO 1.0	3	.0504	.0312	.147
	LIMESTONE	5	V	.10 TO 1.0	6	.112	.0771	.214
	LIMESTONE	6	V	.10 TO 1.0	4	.190	.123	.450
	LIMESTONE	4	ZN	.01 TO .10	3	.0107	.00662	.0312
	LIMESTONE	5	ZN	.01 TO .10	6	.0176	.0121	.0337
	LIMESTONE	6	ZN	.001 TO .01	2	.00161	.000931	.00712
	LIMESTONE	6	ZN	.01 TO .10	1	.0588	.0300	.938
AA								
	SHALE	5	LI	.01 TO .10	2	0	0	0
	INTERBURDEN	5	LI	.01 TO .10	2	0	0	0
	INTERBURDEN	6	LI	.01 TO .10	3	.0147	.00912	.0430
	SANDSTONE	5	LI	.01 TO .10	3	.00816	.00506	.0238
	GLACIAL TILL	5	LI	.01 TO .10	1	0	0	0
	ALLUVIUM	5	LI	.01 TO .10	3	.0100	.00620	.0292
	LIMESTONE	5	LI	.01 TO .10	4	.0117	.00761	.0278
	LIMESTONE	6	LI	.01 TO .10	1	.0283	.0144	.451
WET CHEMISTRY								
	SHALE	4	COND	1000 TO 10000	3	353	218	1030
	SHALE	5	COND	1000 TO 10000	6	173	120	332
	SHALE	6	COND	1000 TO 10000	5	31.3	21.6	65.4
	SHALE	4	F	.10 TO 1.0	3	.0310	.0192	.0904
	SHALE	5	F	.10 TO 1.0	6	.0714	.0493	.137
	SHALE	6	F	.10 TO 1.0	5	.0184	.0124	.0385
	SHALE	4	PH	10.0 TO 100.0	3	1.48	.919	4.33
	SHALE	5	PH	10.0 TO 100.0	6	.0191	.0132	.0367
	SHALE	6	PH	1.0 TO 10.0	5	.0957	.0643	.200

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SHALE	4	SO4	100 TO 1000	3	10.0	6.20	29.2
	SHALE	5	SO4	100 TO 1000	1	0	0	0
	SHALE	5	SO4	1000 TO 10000	5	7.07	4.75	14.8
	SHALE	6	SO4	100 TO 1000	4	13.2	8.59	31.4
	SHALE	6	SO4	1000 TO 10000	1	0	0	0
	SHALE	4	TDS	1000 TO 10000	3	28.7	17.8	83.9
	SHALE	5	TDS	1000 TO 10000	6	126	86.8	241
	SHALE	6	TDS	1000 TO 10000	5	119	79.8	248
	INTERBURDEN	4	COND	1000 TO 10000	3	896	555	2610
	INTERBURDEN	5	COND	1000 TO 10000	6	709	489	1360
	INTERBURDEN	6	COND	1000 TO 10000	5	78.4	52.7	164
	INTERBURDEN	4	CL	1.0 TO 10.0	1	.566	.289	9.02
	INTERBURDEN	5	CL	.10 TO 1.0	2	.0224	.0129	.0987
	INTERBURDEN	6	CL	1.0 TO 10.0	1	.0495	.0253	.789
	INTERBURDEN	4	F	.10 TO 1.0	3	.269	.167	.787
	INTERBURDEN	5	F	.10 TO 1.0	6	.0364	.0251	.0697
	INTERBURDEN	6	F	.10 TO 1.0	2	.0224	.0129	.0987
	INTERBURDEN	6	F	1.0 TO 10.0	3	.0603	.0373	.176
	INTERBURDEN	4	PH	10.0 TO 100.0	3	.514	.318	1.50
	INTERBURDEN	5	PH	10.0 TO 100.0	6	.0639	.0441	.122
	INTERBURDEN	6	PH	1.0 TO 10.0	5	.318	.214	.664
	INTERBURDEN	4	SO4	1000 TO 10000	3	49.3	30.6	144
	INTERBURDEN	5	SO4	1000 TO 10000	6	25.7	17.7	49.1
	INTERBURDEN	6	SO4	1000 TO 10000	5	30.7	20.6	64.1
	INTERBURDEN	4	TDS	1000 TO 10000	3	220	137	643
	INTERBURDEN	5	TDS	1000 TO 10000	6	98.3	67.9	188
	INTERBURDEN	6	TDS	1000 TO 10000	5	92.6	62.3	194
	SANDSTONE	4	TOC	1.0 TO 10.0	1	.919	.469	14.7
	SANDSTONE	5	COND	1000 TO 10000	3	586	363	1710
	SANDSTONE	6	COND	1000 TO 10000	6	715	493	1370
	SANDSTONE	6	COND	1000 TO 10000	5	59.3	39.9	124
	SANDSTONE	4	CL	.001 TO .01	1	0	0	0
	SANDSTONE	5	F	.10 TO 1.0	3	.0350	.0217	.102
			F	.10 TO 1.0	5	.0472	.0317	.0987

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SANDSTONE	6	F	.10 TO 1.0	5	.0110	.00736	.0229
	SANDSTONE	4	PH	10.0 TO 100.0	3	.262	.163	.766
	SANDSTONE	5	PH	10.0 TO 100.0	5	.0315	.0217	.0603
	SANDSTONE	6	PH	1.0 TO 10.0	4	.0460	.0298	.109
	SANDSTONE	6	PH	10.0 TO 100.0	1	.0212	.0108	.338
	SANDSTONE	4	SO4	100 TO 1000	3	12.6	7.80	36.7
	SANDSTONE	5	SO4	1000 TO 10000	6	43.9	30.3	84.0
	SANDSTONE	6	SO4	100 TO 1000	1	21.2	10.8	338
	SANDSTONE	6	SO4	1000 TO 10000	4	35.4	23.0	83.9
	SANDSTONE	4	TDS	1000 TO 10000	3	253	157	738
	SANDSTONE	5	TDS	1000 TO 10000	6	102	70.5	196
	SANDSTONE	6	TDS	1000 TO 10000	5	274	184	572
	GLACIAL TILL	4	COND	1000 TO 10000	3	404	250	1180
	GLACIAL TILL	5	COND	1000 TO 10000	6	388	266	743
	GLACIAL TILL	6	COND	1000 TO 10000	5	31.0	20.8	64.7
	GLACIAL TILL	4	F	.10 TO 1.0	3	.0387	.0240	.113
	GLACIAL TILL	5	F	.10 TO 1.0	5	.0773	.0520	.162
	GLACIAL TILL	6	F	.10 TO 1.0	3	.0867	.0537	.253
	GLACIAL TILL	6	F	1.0 TO 10.0	2	.00707	.00409	.0312
	GLACIAL TILL	4	PH	10.0 TO 100.0	3	2.24	1.39	6.53
	GLACIAL TILL	5	PH	10.0 TO 100.0	6	.0289	.0199	.0553
	GLACIAL TILL	6	PH	1.0 TO 10.0	5	.0694	.0467	.145
	GLACIAL TILL	4	SO4	100 TO 1000	3	52.0	32.2	152
	GLACIAL TILL	5	SO4	100 TO 1000	2	10.0	5.78	44.2
	GLACIAL TILL	5	SO4	1000 TO 10000	4	15.0	9.74	35.6
	GLACIAL TILL	6	SO4	100 TO 1000	5	8.37	5.62	17.5
	GLACIAL TILL	4	TDS	1000 TO 10000	3	65.6	40.6	191
	GLACIAL TILL	5	TDS	1000 TO 10000	6	182	125	348
	GLACIAL TILL	6	TDS	1000 TO 10000	5	96.4	64.8	201
	ALLUVIUM	4	COND	1000 TO 10000	3	163	101	475
	ALLUVIUM	5	COND	1000 TO 10000	6	181	125	346
	ALLUVIUM	6	COND	1000 TO 10000	5	58.7	39.4	123
	ALLUVIUM	4	F	.10 TO 1.0	3	.0332	.0205	.0968
	ALLUVIUM	5	F	.10 TO 1.0	5	.0597	.0402	.125

TABLE H-13. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	ALLUVIUM	6	F	.01 TO .10	2	0	0	0
	ALLUVIUM	6	F	.10 TO 1.0	3	.00577	.00358	.0169
	ALLUVIUM	4	PH	10.0 TO 100.0	3	.231	.143	.675
	ALLUVIUM	5	PH	10.0 TO 100.0	6	.0460	.0318	.0881
	ALLUVIUM	6	PH	1.0 TO 10.0	4	.0827	.0537	.196
	ALLUVIUM	6	PH	10.0 TO 100.0	1	.163	.0830	2.59
	ALLUVIUM	4	SO4	100 TO 1000	3	54.5	33.7	159
	ALLUVIUM	5	SO4	100 TO 1000	1	7.07	3.61	113
	ALLUVIUM	5	SO4	1000 TO 10000	5	13.0	8.76	27.2
	ALLUVIUM	6	SO4	100 TO 1000	5	15.8	10.6	33.0
	ALLUVIUM	4	TDS	1000 TO 10000	3	136	84.5	398
	ALLUVIUM	5	TDS	1000 TO 10000	6	156	108	299
	ALLUVIUM	6	TDS	100 TO 1000	1	84.9	43.3	1350
	ALLUVIUM	6	TDS	1000 TO 10000	4	47.4	30.8	113
	ALLUVIUM	4	TOC	1.0 TO 10.0	1	.141	.0722	2.26
	LIMESTONE	4	COND	1000 TO 10000	3	1150	710	3340
	LIMESTONE	5	COND	1000 TO 10000	6	177	122	339
	LIMESTONE	6	COND	1000 TO 10000	5	53.0	35.6	111
	LIMESTONE	4	F	.10 TO 1.0	3	.154	.0953	.449
	LIMESTONE	5	F	.10 TO 1.0	2	.0206	.0119	.0910
	LIMESTONE	6	F	.10 TO 1.0	4	.145	.0939	.343
	LIMESTONE	6	F	1.0 TO 10.0	1	.0283	.0144	.451
	LIMESTONE	4	PH	10.0 TO 100.0	3	.279	.173	.815
	LIMESTONE	5	PH	10.0 TO 100.0	6	.0173	.0120	.0332
	LIMESTONE	6	PH	1.0 TO 10.0	4	.207	.134	.491
	LIMESTONE	6	PH	10.0 TO 100.0	1	.113	.0577	1.80
	LIMESTONE	4	SO4	100 TO 1000	3	29.4	18.2	86.0
	LIMESTONE	5	SO4	1000 TO 10000	6	18.3	12.6	35.0
	LIMESTONE	6	SO4	100 TO 1000	5	21.3	14.3	44.5
	LIMESTONE	4	TDS	1000 TO 10000	2	277	160	1220
	LIMESTONE	5	TDS	1000 TO 10000	6	531	366	1020
	LIMESTONE	6	TDS	1000 TO 10000	5	42.9	28.8	89.6
	LIMESTONE	4	TOC	1.0 TO 10.0	1	.0707	.0361	1.13

Appendix H

Attachment 3

Table H-14

Preceding page blank

TABLE H-14. UNCERTAINTIES FOR LABORATORY DATA: LEACHING DATA FOR ALLIANCE AFBC WASTE

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
ICPES								
		1	AL	.10 TO 1.0	7	.0695	.0491	.125
		2	AL	.10 TO 1.0	3	.0532	.0330	.155
		2	AL	1.0 TO 10.0	6	.183	.126	.350
		3	AL	.10 TO 1.0	1	.0502	.0256	.801
		3	AL	1.0 TO 10.0	4	.163	.106	.386
		1	B	1.0 TO 10.0	7	.337	.238	.605
		2	B	.10 TO 1.0	1	.0127	.00649	.203
		2	B	1.0 TO 10.0	8	.815	.586	1.39
		3	B	.10 TO 1.0	1	.233	.119	3.71
		3	B	1.0 TO 10.0	5	.628	.422	1.31
		1	BA	.10 TO 1.0	7	.0141	.00991	.0253
		2	BA	.01 TO .10	6	.00765	.00528	.0147
		3	BA	.01 TO .10	1	.0170	.00866	.271
		3	BA	.10 TO 1.0	5	.0344	.0231	.0718
		1	BE	.001 TO .01	7	.000707	.000499	.00127
		2	BE	.001 TO .01	3	.000577	.000358	.00169
		2	BE	.01 TO .10	2	.00316	.00183	.0140
		3	BE	.001 TO .01	5	.00105	.000705	.00219
		1	CA	1000 TO 10000	5	74.6	50.1	156
		2	CA	1000 TO 10000	3	69.4	50.6	114
		3	CA	1000 TO 10000	6	339	234	649
		1	CD	.01 TO .10	7	.00498	.00352	.00896
		2	CD	.01 TO .10	8	.0109	.00783	.0187
		3	CD	.01 TO .10	5	.00777	.00522	.0162
		1	CO	.01 TO .10	7	.00789	.00557	.0142
		2	CO	.01 TO .10	4	.00760	.00493	.0180
		2	CO	.10 TO 1.0	5	.0226	.0152	.0472
		3	CO	.01 TO .10	4	.00661	.00429	.0157
		3	CO	.10 TO 1.0	2	.0175	.0101	.0774
		1	CR	.01 TO .10	7	.0109	.00770	.0196

TABLE H-14. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
		2	CR	.01 TO .10	2	.00559	.00323	.0247
		2	CR	.10 TO 1.0	7	.0263	.0185	.0472
		3	CR	.01 TO .10	1	.00990	.00505	.158
		3	CR	.10 TO 1.0	5	.0145	.00974	.0303
		1	CU	.01 TO .10	7	.0109	.00769	.0196
		2	CU	.01 TO .10	2	.00474	.00274	.0209
		2	CU	.10 TO 1.0	7	.0301	.0212	.0540
		3	CU	.01 TO .10	2	.00716	.00414	.0316
		3	CU	.10 TO 1.0	4	.0165	.0107	.0391
		1	FE	.01 TO .10	7	.00671	.00474	.0121
		2	FE	.01 TO .10	6	.00823	.00568	.0158
		2	FE	.10 TO 1.0	2	.0402	.0232	.177
		3	FE	.01 TO .10	6	.0135	.00931	.0258
		1	K	10.0 TO 100.0	7	3.07	2.17	5.52
		2	K	1.0 TO 10.0	3	.342	.212	1.00
		2	K	10.0 TO 100.0	6	.809	.559	1.55
		3	K	10.0 TO 100.0	1	4.72	2.41	75.3
		3	K	100 TO 1000	5	17.5	11.7	36.5
		1	LI	.10 TO 1.0	7	.0207	.0146	.0372
		2	LI	.10 TO 1.0	6	.0225	.0156	.0432
		3	LI	.10 TO 1.0	2	.0264	.0153	.117
		3	LI	1.0 TO 10.0	4	.107	.0692	.253
		2	MG	.01 TO .10	4	.00203	.00132	.00482
		2	MG	1.0 TO 10.0	5	.304	.204	.635
		3	MG	.01 TO .10	1	0	0	0
		3	MG	.10 TO 1.0	2	.0797	.0460	.352
		3	MG	1.0 TO 10.0	3	.340	.210	.992
		1	MN	.001 TO .01	7	.00155	.00110	.00279
		2	MN	.001 TO .01	2	.00100	.000578	.00442
		2	MN	.01 TO .10	7	.00358	.00252	.00643
		3	MN	.001 TO .01	1	.00141	.000722	.0226
		3	MN	.01 TO .10	5	.00272	.00183	.00568
		1	MO	.10 TO 1.0	7	.0166	.0117	.0298
		2	MO	.10 TO 1.0	9	.0259	.0189	.0427

TABLE H-14. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
		3	MO	.10 TO 1.0	6	.0236	.0163	.0452
		1	NA	10.0 TO 100.0	7	.606	.428	1.09
		2	NA	1.0 TO 10.0	9	.146	.106	.240
		3	NA	10.0 TO 100.0	6	4.87	3.36	9.32
		1	NI	.01 TO .10	7	.00780	.00550	.0140
		2	NI	.01 TO .10	1	.00919	.00469	.147
		2	NI	.10 TO 1.0	7	.0223	.0157	.0400
		3	NI	.01 TO .10	1	.00778	.00397	.124
		3	NI	.10 TO 1.0	4	.0182	.0118	.0433
		1	SI	.10 TO 1.0	7	.0466	.0329	.0837
		2	SI	.10 TO 1.0	9	.116	.0845	.191
		3	SI	.10 TO 1.0	6	.0497	.0343	.0952
		1	SR	10.0 TO 100.0	5	1.23	.828	2.57
		2	SR	1.0 TO 10.0	8	.150	.107	.256
		2	SR	10.0 TO 100.0	1	.249	.127	3.97
		3	SR	10.0 TO 100.0	5	8.68	5.99	16.6
		1	TI	.10 TO 1.0	7	.0263	.0186	.0473
		2	TI	.01 TO .10	1	.00354	.00180	.0564
		2	TI	.10 TO 1.0	8	.0626	.0449	.107
		3	TI	.01 TO .10	1	.0106	.00541	.169
		3	TI	.10 TO 1.0	5	.0449	.0302	.0937
		1	V	.10 TO 1.0	7	.0286	.0202	.0514
		2	V	.01 TO .10	1	.00212	.00108	.0338
		2	V	.10 TO 1.0	8	.0523	.0376	.0895
		3	V	.01 TO .10	1	.00990	.00505	.158
		3	V	.10 TO 1.0	5	.0399	.0268	.0635
		1	ZN	.01 TO .10	7	.00579	.00409	.0104
		2	ZN	.01 TO .10	8	.00955	.00686	.0163
		3	ZN	.01 TO .10	6	.00365	.00252	.00699
WET CHEMISTRY								
		1	COND	1000 TO 10000	7	183	129	329
		2	COND	1000 TO 10000	9	71.7	52.3	118

TABLE H-14. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
		3	COND	1000 TO 10000	5	59.1	39.7	123
		3	COND	10000 TO 100000	1	0	0	0
		1	C1	10.0 TO 100.0	7	.916	.646	1.65
		2	C1	1.0 TO 10.0	1	0	0	0
		2	C1	10.0 TO 100.0	1	0	0	0
		3	C1	100 TO 1000	6	4.65	3.21	8.90
		1	F	.10 TO 1.0	7	.0475	.0335	.0854
		2	F	.01 TO .10	1	.0141	.00722	.226
		2	F	.10 TO 1.0	8	.0242	.0174	.0415
		3	F	.10 TO 1.0	6	.0386	.0267	.0740
		1	PH	10.0 TO 100.0	7	.0243	.0172	.0438
		2	PH	10.0 TO 100.0	9	.0236	.0172	.0388
		3	PH	10.0 TO 100.0	6	.0115	.00797	.0221
		1	SO4	1000 TO 10000	7	17.7	12.5	31.8
		2	SO4	1000 TO 10000	9	12.2	8.93	20.1
		3	SO4	1000 TO 10000	6	26.3	18.2	50.4
		1	TDS	1000 TO 10000	7	58.3	41.1	105
		2	TDS	1000 TO 10000	9	60.9	44.4	100
		3	TDS	1000 TO 10000	6	41.2	28.5	79.0
		1	TOC	1.0 TO 10.0	1	.990	.505	15.8

Appendix H

Attachment 4

Table H-15

Preceding page blank

TABLE H-15. UNCERTAINTIES FOR LABORATORY DATA: ATTENUATION DATA FOR ALLIANCE AFBC WASTE

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
ICPES								
	SHALE	4	AL	.10 TO 1.0	1	.0318	.0162	.507
	SHALE	5	AL	.01 TO .10	1	.0424	.0216	.677
	SHALE	5	AL	.10 TO 1.0	5	.0675	.0454	.141
	SHALE	5	AL	1.0 TO 10.0	3	.360	.223	1.05
	SHALE	6	AL	.10 TO 1.0	4	.0968	.0629	.230
	SHALE	6	AL	1.0 TO 10.0	1	.0318	.0162	.507
	SHALE	4	B	1.0 TO 10.0	1	.0410	.0209	.654
	SHALE	5	B	.10 TO 1.0	1	.254	.130	4.05
	SHALE	5	B	1.0 TO 10.0	8	.760	.546	1.30
	SHALE	6	B	1.0 TO 10.0	5	.314	.211	.656
	SHALE	4	BA	.01 TO .10	1	.00283	.00144	.0451
	SHALE	5	BA	.01 TO .10	5	.0173	.0116	.0362
	SHALE	5	BA	.10 TO 1.0	4	.0174	.0113	.0413
	SHALE	6	BA	.01 TO .10	4	.00433	.00281	.0103
	SHALE	6	BA	.10 TO 1.0	1	0	0	0
	SHALE	4	BE	.001 TO .01	1	.000707	.000361	.0113
	SHALE	5	BE	.001 TO .01	4	.000500	.000325	.00119
	SHALE	6	BE	.001 TO .01	2	.000500	.000289	.00221
	SHALE	4	CA	100 TO 1000	1	.212	.108	3.38
	SHALE	5	CA	100 TO 1000	6	37.1	25.6	71.0
	SHALE	5	CA	1000 TO 10000	3	27.2	16.8	79.3
	SHALE	6	CA	100 TO 1000	5	9.44	6.35	19.7
	SHALE	4	CD	.01 TO .10	1	.000707	.000361	.0113
	SHALE	5	CD	.01 TO .10	8	.00930	.00668	.0159
	SHALE	6	CD	.01 TO .10	3	.00365	.00226	.0107
	SHALE	4	CO	.01 TO .10	1	.00354	.00180	.0564
	SHALE	5	CO	.01 TO .10	8	.00752	.00540	.0129
	SHALE	5	CO	.10 TO 1.0	1	.0410	.0209	.654
	SHALE	6	CO	.01 TO .10	5	.00957	.00643	.0200
	SHALE	4	CR	.01 TO .10	1	1.3E-09	6.7E-10	2.1E-08

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SHALE	5	CR	.01 TO .10	1	.0106	.00541	.169
	SHALE	5	CR	.10 TO 1.0	8	.0235	.0169	.0402
	SHALE	6	CR	.01 TO .10	5	.00987	.00664	.0206
	SHALE	4	CU	.01 TO .10	1	.00283	.00144	.0451
	SHALE	5	CU	.01 TO .10	2	.00461	.00266	.0204
	SHALE	5	CU	.10 TO 1.0	7	.0352	.0249	.0633
	SHALE	6	CU	.01 TO .10	5	.0139	.00937	.0291
	SHALE	4	FE	.01 TO .10	1	.000707	.000361	.0113
	SHALE	5	FE	.01 TO .10	5	.0276	.0185	.0576
	SHALE	5	FE	.10 TO 1.0	4	.0648	.0421	.154
	SHALE	6	FE	.01 TO .10	4	.00612	.00398	.0145
	SHALE	6	FE	.10 TO 1.0	1	.0962	.0491	1.53
	SHALE	4	K	10.0 TO 100.0	1	.170	.0866	2.71
	SHALE	5	K	10.0 TO 100.0	9	1.67	1.22	2.75
	SHALE	6	K	10.0 TO 100.0	5	.352	.236	.735
	SHALE	4	LI	.01 TO .10	1	.000707	.000361	.0113
	SHALE	5	LI	.01 TO .10	1	.00424	.00216	.0677
	SHALE	5	LI	.10 TO 1.0	4	.00695	.00451	.0165
	SHALE	6	LI	.01 TO .10	2	.00502	.00290	.0222
	SHALE	4	MG	.01 TO .10	1	.000707	.000361	.0113
	SHALE	5	MG	.01 TO .10	3	.0134	.00829	.0390
	SHALE	5	MG	1.0 TO 10.0	4	.320	.208	.760
	SHALE	6	MG	1.0 TO 10.0	1	.361	.184	5.75
	SHALE	6	MG	10.0 TO 100.0	4	.820	.532	1.95
	SHALE	4	MN	.001 TO .01	1	8.2E-11	4.2E-11	1.3E-09
	SHALE	5	MN	.001 TO .01	1	.00424	.00216	.0677
	SHALE	5	MN	.01 TO .10	8	.00373	.00268	.00639
	SHALE	6	MN	.01 TO .10	1	.00424	.00216	.0677
	SHALE	6	MN	.10 TO 1.0	2	.0219	.0127	.0968
	SHALE	6	MN	1.0 TO 10.0	2	.0526	.0304	.232
	SHALE	4	MO	.10 TO 1.0	1	.00141	.000722	.0226
	SHALE	5	MO	.10 TO 1.0	9	.0192	.0140	.0316
	SHALE	6	MO	.01 TO .10	1	.000707	.000361	.0113
	SHALE	6	MO	.10 TO 1.0	4	.0137	.00890	.0325

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SHALE	4	NA	10.0 TO 100.0	1	.0212	.0108	.338
	SHALE	5	NA	10.0 TO 100.0	9	.667	.486	1.10
	SHALE	6	NA	10.0 TO 100.0	5	.329	.221	.688
	SHALE	4	NI	.01 TO .10	1	9.3E-10	4.8E-10	1.5E-08
	SHALE	5	NI	.01 TO .10	2	.00982	.00568	.0434
	SHALE	5	NI	.10 TO 1.0	6	.0165	.0114	.0316
	SHALE	6	NI	.01 TO .10	5	.00863	.00580	.0180
	SHALE	4	SI	1.0 TO 10.0	1	.0474	.0242	.756
	SHALE	5	SI	.10 TO 1.0	9	.0726	.0530	.119
	SHALE	6	SI	1.0 TO 10.0	5	.108	.0725	.225
	SHALE	4	SR	10.0 TO 100.0	1	.0495	.0253	.789
	SHALE	5	SR	10.0 TO 100.0	9	.766	.559	1.26
	SHALE	6	SR	1.0 TO 10.0	5	.0526	.0354	.110
	SHALE	4	TI	.10 TO 1.0	1	.00354	.00180	.0564
	SHALE	5	TI	.01 TO .10	1	.0177	.00902	.282
	SHALE	5	TI	.10 TO 1.0	8	.0738	.0530	.126
	SHALE	6	TI	.01 TO .10	1	.00212	.00108	.0338
	SHALE	6	TI	.10 TO 1.0	4	.0356	.0231	.0845
	SHALE	4	V	.10 TO 1.0	1	.00778	.00397	.124
	SHALE	5	V	.01 TO .10	1	.00212	.00108	.0338
	SHALE	5	V	.10 TO 1.0	8	.0555	.0399	.0850
	SHALE	6	V	.01 TO .10	2	.00825	.00476	.0364
	SHALE	6	V	.10 TO 1.0	3	.0274	.0170	.0802
	SHALE	4	ZN	.01 TO .10	1	0	0	0
	SHALE	5	ZN	.01 TO .10	8	.00651	.00468	.0111
	SHALE	6	ZN	.01 TO .10	5	.00493	.00331	.0103
	INTERBURDEN	4	AL	.10 TO 1.0	3	.700	.434	2.04
	INTERBURDEN	5	AL	.10 TO 1.0	2	.0868	.0502	.383
	INTERBURDEN	5	AL	1.0 TO 10.0	6	.293	.202	.560
	INTERBURDEN	6	AL	1.0 TO 10.0	5	.119	.0802	.249
	INTERBURDEN	4	B	1.0 TO 10.0	3	2.27	1.41	6.64
	INTERBURDEN	5	B	1.0 TO 10.0	8	.910	.654	1.56
	INTERBURDEN	6	B	1.0 TO 10.0	5	.258	.173	.539
	INTERBURDEN	4	BA	.01 TO .10	3	.0279	.0173	.0815

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	INTERBURDEN	5	BA	.01 TO .10	9	.0176	.0129	.0290
	INTERBURDEN	6	BA	.001 TO .01	1	.00778	.00397	.124
	INTERBURDEN	6	BA	.01 TO .10	3	.00570	.00353	.0166
	INTERBURDEN	5	BE	.001 TO .01	4	.000612	.000398	.00145
	INTERBURDEN	6	BE	.01 TO .10	2	0	0	0
	INTERBURDEN	4	CA	100 TO 1000	3	72.0	44.6	210
	INTERBURDEN	5	CA	100 TO 1000	6	44.5	30.7	85.2
	INTERBURDEN	5	CA	1000 TO 10000	3	15.6	9.65	45.5
	INTERBURDEN	6	CA	100 TO 1000	5	6.55	4.40	13.7
	INTERBURDEN	5	CD	.01 TO .10	8	.0106	.00759	.0181
	INTERBURDEN	6	CD	.01 TO .10	5	.00341	.00229	.00712
	INTERBURDEN	5	CO	.01 TO .10	5	.0209	.0141	.0437
	INTERBURDEN	5	CO	.10 TO 1.0	3	.0154	.00953	.0449
	INTERBURDEN	6	CO	.01 TO .10	1	.00707	.00361	.113
	INTERBURDEN	6	CO	.10 TO 1.0	2	.0229	.0133	.101
	INTERBURDEN	6	CO	1.0 TO 10.0	2	.00906	.00523	.0400
	INTERBURDEN	4	CR	.01 TO .10	3	.0710	.0440	.207
	INTERBURDEN	5	CR	.001 TO .01	1	.00424	.00216	.0677
	INTERBURDEN	5	CR	.10 TO 1.0	8	.0286	.0205	.0489
	INTERBURDEN	6	CR	.01 TO .10	4	.00523	.00340	.0124
	INTERBURDEN	6	CR	.10 TO 1.0	1	.0163	.00830	.259
	INTERBURDEN	4	CU	.01 TO .10	3	.104	.0646	.305
	INTERBURDEN	5	CU	.01 TO .10	1	.00424	.00216	.0677
	INTERBURDEN	5	CU	.10 TO 1.0	8	.0378	.0271	.0646
	INTERBURDEN	6	CU	.10 TO 1.0	4	.0280	.0182	.0665
	INTERBURDEN	6	CU	1.0 TO 10.0	1	.0163	.00830	.259
	INTERBURDEN	5	FE	.01 TO .10	8	.0124	.00894	.0213
	INTERBURDEN	6	FE	.01 TO .10	1	.00566	.00289	.0902
	INTERBURDEN	6	FE	.10 TO 1.0	1	.0714	.0364	1.14
	INTERBURDEN	6	FE	1.0 TO 10.0	3	.167	.104	.488
	INTERBURDEN	4	K	10.0 TO 100.0	3	3.19	1.98	9.32
	INTERBURDEN	5	K	10.0 TO 100.0	9	1.27	.923	2.08
	INTERBURDEN	6	K	10.0 TO 100.0	5	.857	.576	1.79
	INTERBURDEN	4	LI	.01 TO .10	1	.00141	.000722	.0226

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	INTERBURDEN	5	LT	.01 TO .10	1	.00141	.000722	.0226
	INTERBURDEN	5	LT	.10 TO 1.0	4	.00541	.00351	.0128
	INTERBURDEN	6	LT	.10 TO 1.0	2	.00250	.00144	.0110
	INTERBURDEN	4	MG	100 TO 1000	3	207	129	606
	INTERBURDEN	5	MG	.01 TO .10	3	.00334	.00207	.00976
	INTERBURDEN	5	MG	1.0 TO 10.0	4	.357	.232	.848
	INTERBURDEN	5	MG	10.0 TO 100.0	1	0	0	0
	INTERBURDEN	6	MG	1.0 TO 10.0	1	.195	.0996	3.11
	INTERBURDEN	6	MG	10.0 TO 100.0	3	.444	.275	1.30
	INTERBURDEN	6	MG	100 TO 1000	1	.566	.249	9.02
	INTERBURDEN	4	MN	.01 TO .10	3	.0106	.00658	.0310
	INTERBURDEN	5	MN	.001 TO .01	1	.000707	.000361	.0113
	INTERBURDEN	5	MN	.01 TO .10	8	.00429	.00308	.00733
	INTERBURDEN	6	MN	.01 TO .10	1	.00141	.000722	.0226
	INTERBURDEN	6	MN	.10 TO 1.0	2	.0271	.0156	.120
	INTERBURDEN	6	MN	1.0 TO 10.0	2	.0132	.00760	.0581
	INTERBURDEN	4	MO	.10 TO 1.0	3	.0200	.0124	.0583
	INTERBURDEN	5	MO	.10 TO 1.0	9	.0106	.00770	.0174
	INTERBURDEN	6	MO	.01 TO .10	4	.00581	.00377	.0138
	INTERBURDEN	6	MO	.10 TO 1.0	1	.00212	.00108	.0338
	INTERBURDEN	4	NA	10.0 TO 100.0	3	.929	.575	2.71
	INTERBURDEN	5	NA	10.0 TO 100.0	9	.431	.315	.710
	INTERBURDEN	6	NA	10.0 TO 100.0	5	.446	.300	.931
	INTERBURDEN	5	NI	.10 TO 1.0	8	.0222	.0160	.0381
	INTERBURDEN	6	NI	.01 TO .10	1	.00849	.00433	.135
	INTERBURDEN	6	NI	.10 TO 1.0	1	.00849	.00433	.135
	INTERBURDEN	6	NI	1.0 TO 10.0	3	.0302	.0187	.0883
	INTERBURDEN	4	SI	1.0 TO 10.0	3	.187	.116	.547
	INTERBURDEN	5	SI	.10 TO 1.0	9	.0632	.0461	.104
	INTERBURDEN	6	SI	1.0 TO 10.0	1	.0955	.0487	1.52
	INTERBURDEN	6	SI	10.0 TO 100.0	4	.235	.152	.556
	INTERBURDEN	4	SR	10.0 TO 100.0	3	1.66	1.03	4.84
	INTERBURDEN	5	SR	10.0 TO 100.0	9	.970	.708	1.60
	INTERBURDEN	6	SR	1.0 TO 10.0	5	.135	.0909	.283

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	INTERBURDEN	4	TI	.10 TO 1.0	3	.227	.141	.664
	INTERBURDEN	5	TI	.01 TO .10	1	.0106	.00541	.169
	INTERBURDEN	5	TI	.10 TO 1.0	8	.0860	.0618	.147
	INTERBURDEN	6	TI	.01 TO .10	1	.000707	.000361	.0113
	INTERBURDEN	6	TI	.10 TO 1.0	4	.0312	.0203	.0741
	INTERBURDEN	4	V	.10 TO 1.0	3	.168	.104	.490
	INTERBURDEN	5	V	.01 TO .10	1	.0148	.00758	.237
	INTERBURDEN	5	V	.10 TO 1.0	8	.0624	.0448	.107
	INTERBURDEN	6	V	.01 TO .10	1	.00849	.00433	.135
	INTERBURDEN	6	V	.10 TO 1.0	4	.0271	.0176	.0642
	INTERBURDEN	5	ZN	.01 TO .10	8	.00893	.00641	.0153
	INTERBURDEN	6	ZN	.01 TO .10	1	.00283	.00144	.0451
	INTERBURDEN	6	ZN	.10 TO 1.0	1	.0410	.0209	.654
	INTERBURDEN	6	ZN	1.0 TO 10.0	3	.0686	.0425	.200
	SANDSTONE	4	AL	.10 TO 1.0	3	.260	.161	.760
	SANDSTONE	5	AL	.10 TO 1.0	4	.0883	.0574	.210
	SANDSTONE	5	AL	1.0 TO 10.0	5	.421	.283	.879
	SANDSTONE	6	AL	.10 TO 1.0	4	.0435	.0283	.103
	SANDSTONE	6	AL	1.0 TO 10.0	1	.000707	.000361	.0113
	SANDSTONE	4	B	.10 TO 1.0	3	.770	.477	2.25
	SANDSTONE	5	B	.10 TO 1.0	1	.0622	.0317	.992
	SANDSTONE	5	B	1.0 TO 10.0	8	1.08	.773	1.84
	SANDSTONE	6	B	.10 TO 1.0	4	.146	.0947	.346
	SANDSTONE	6	B	1.0 TO 10.0	1	.161	.0823	2.57
	SANDSTONE	5	BA	.01 TO .10	9	.0167	.0122	.0274
	SANDSTONE	6	BA	.01 TO .10	3	.00666	.00413	.0194
	SANDSTONE	5	BE	.001 TO .01	4	.000935	.000607	.00222
	SANDSTONE	6	BE	.001 TO .01	3	.000408	.000253	.00119
	SANDSTONE	4	CA	100 TO 1000	3	116	71.8	338
	SANDSTONE	5	CA	100 TO 1000	5	76.6	51.5	160
	SANDSTONE	5	CA	1000 TO 10000	4	25.5	16.6	60.5
	SANDSTONE	6	CA	100 TO 1000	5	6.48	4.36	13.5
	SANDSTONE	5	CD	.01 TO .10	8	.0129	.00923	.0220
	SANDSTONE	6	CD	.01 TO .10	1	.00141	.000722	.0226

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SANDSTONE	4	CO	.01 TO .10	3	.0151	.00937	.0442
	SANDSTONE	5	CO	.01 TO .10	4	.00937	.00609	.0222
	SANDSTONE	5	CO	.10 TO 1.0	4	.0345	.0224	.0818
	SANDSTONE	6	CO	.01 TO .10	5	.00214	.00144	.00448
	SANDSTONE	4	CR	.01 TO .10	3	.0202	.0125	.0589
	SANDSTONE	5	CR	.01 TO .10	3	.0112	.00693	.0326
	SANDSTONE	5	CR	.10 TO 1.0	6	.0380	.0262	.0728
	SANDSTONE	6	CR	.01 TO .10	5	.00463	.00311	.00966
	SANDSTONE	4	CU	.01 TO .10	3	.0321	.0199	.0938
	SANDSTONE	5	CU	.01 TO .10	3	.0120	.00740	.0349
	SANDSTONE	5	CU	.10 TO 1.0	6	.0558	.0385	.107
	SANDSTONE	6	CU	.01 TO .10	5	.00596	.00400	.0124
	SANDSTONE	5	FE	.01 TO .10	3	.0107	.00664	.0313
	SANDSTONE	5	FE	.10 TO 1.0	5	.0447	.0300	.0933
	SANDSTONE	6	FE	.01 TO .10	3	.0222	.0137	.0647
	SANDSTONE	6	FE	.10 TO 1.0	2	.0623	.0360	.275
	SANDSTONE	4	K	10.0 TO 100.0	3	1.03	.638	3.01
	SANDSTONE	5	K	10.0 TO 100.0	9	1.62	1.18	2.66
	SANDSTONE	6	K	10.0 TO 100.0	5	1.06	.716	2.23
	SANDSTONE	4	LI	.01 TO .10	1	.00424	.00216	.0677
	SANDSTONE	5	LI	.10 TO 1.0	5	.00907	.00610	.0190
	SANDSTONE	6	LI	.01 TO .10	5	.00548	.00368	.0114
	SANDSTONE	5	MG	.01 TO .10	3	.00481	.00298	.0141
	SANDSTONE	5	MG	1.0 TO 10.0	4	.459	.298	1.09
	SANDSTONE	6	MG	10.0 TO 100.0	1	.445	.227	7.10
	SANDSTONE	6	MG	.10 TO 1.0	1	.00849	.00433	.135
	SANDSTONE	4	MN	10.0 TO 100.0	4	.677	.439	1.61
	SANDSTONE	5	MN	.001 TO .01	3	.00316	.00196	.00923
	SANDSTONE	5	MN	.001 TO .01	1	.000707	.000361	.0113
	SANDSTONE	6	MN	.01 TO .10	8	.00482	.00346	.00825
	SANDSTONE	6	MN	.001 TO .01	1	.00141	.000722	.0226
	SANDSTONE	6	MN	.10 TO 1.0	1	.0205	.0105	.327
	SANDSTONE	6	MN	1.0 TO 10.0	3	.0352	.0218	.103
	SANDSTONE	4	MO	.10 TO 1.0	3	.0133	.00823	.0388

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	SANDSTONE	5	MO	.10 TO 1.0	4	.0180	.0132	.0297
	SANDSTONE	6	MO	.01 TO .10	2	.00447	.00258	.0197
	SANDSTONE	6	MO	.10 TO 1.0	3	.00573	.00355	.0167
	SANDSTONE	4	NA	10.0 TO 100.0	3	1.13	.703	3.31
	SANDSTONE	5	NA	10.0 TO 100.0	9	.772	.563	1.27
	SANDSTONE	6	NA	10.0 TO 100.0	5	.365	.245	.763
	SANDSTONE	5	NI	.01 TO .10	2	.0173	.0100	.0765
	SANDSTONE	5	NI	.10 TO 1.0	6	.0261	.0180	.0500
	SANDSTONE	6	NI	.01 TO .10	5	.00409	.00275	.00854
	SANDSTONE	4	SI	1.0 TO 10.0	3	1.00	.620	2.92
	SANDSTONE	5	SI	.10 TO 1.0	9	.0793	.0578	.130
	SANDSTONE	6	SI	1.0 TO 10.0	5	.276	.186	.577
	SANDSTONE	4	SR	10.0 TO 100.0	3	1.79	1.11	5.23
	SANDSTONE	5	SR	10.0 TO 100.0	9	1.31	.952	2.15
	SANDSTONE	6	SR	1.0 TO 10.0	4	.129	.0840	.307
	SANDSTONE	6	SR	10.0 TO 100.0	1	.290	.148	4.62
	SANDSTONE	4	TI	.10 TO 1.0	3	.0727	.0451	.212
	SANDSTONE	5	TI	.01 TO .10	1	.0113	.00577	.180
	SANDSTONE	5	TI	.10 TO 1.0	8	.106	.0763	.182
	SANDSTONE	6	TI	.01 TO .10	4	.0122	.00794	.0290
	SANDSTONE	6	TI	.10 TO 1.0	1	.00778	.00397	.124
	SANDSTONE	4	V	.01 TO .10	3	.0412	.0255	.120
	SANDSTONE	5	V	.01 TO .10	1	.0163	.00830	.259
	SANDSTONE	5	V	.10 TO 1.0	8	.0825	.0592	.141
	SANDSTONE	6	V	.01 TO .10	5	.0152	.0102	.0318
	SANDSTONE	5	ZN	.01 TO .10	8	.0105	.00757	.0180
	SANDSTONE	6	ZN	.001 TO .01	1	.00283	.00144	.0451
	SANDSTONE	6	ZN	.01 TO .10	4	.00262	.00170	.00622
	GLACIAL TILL	4	AL	.10 TO 1.0	3	.175	.108	.511
	GLACIAL TILL	5	AL	.10 TO 1.0	4	.0825	.0535	.196
	GLACIAL TILL	5	AL	1.0 TO 10.0	4	.296	.192	.703
	GLACIAL TILL	6	AL	.10 TO 1.0	5	.0617	.0415	.129
	GLACIAL TILL	5	B	1.0 TO 10.0	8	.670	.481	1.15
	GLACIAL TILL	6	B	.01 TO .10	1	.0651	.0332	1.04

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	GLACIAL TILL	6	B	.10 TO 1.0	1	.0156	.00794	.248
	GLACIAL TILL	4	BA	.01 TO .10	3	.0400	.0248	.117
	GLACIAL TILL	5	BA	.01 TO .10	3	.0209	.0129	.0610
	GLACIAL TILL	5	BA	.10 TO 1.0	6	.0141	.00970	.0269
	GLACIAL TILL	6	BA	.01 TO .10	4	.0254	.0165	.0602
	GLACIAL TILL	6	BA	.10 TO 1.0	1	.00849	.00433	.135
	GLACIAL TILL	5	BE	.001 TO .01	4	.000612	.000398	.00145
	GLACIAL TILL	4	CA	100 TO 1000	3	24.7	15.3	72.2
	GLACIAL TILL	5	CA	100 TO 1000	8	43.1	31.0	73.7
	GLACIAL TILL	5	CA	1000 TO 10000	1	11.8	6.02	188
	GLACIAL TILL	6	CA	100 TO 1000	5	1.99	1.33	4.15
	GLACIAL TILL	5	CD	.01 TO .10	8	.00907	.00652	.0155
	GLACIAL TILL	5	CO	.01 TO .10	6	.0151	.0104	.0288
	GLACIAL TILL	5	CO	.10 TO 1.0	2	.0190	.0110	.0839
	GLACIAL TILL	6	CO	.001 TO .01	1	.00141	.000722	.0226
	GLACIAL TILL	4	CR	.01 TO .10	3	.00299	.00185	.00872
	GLACIAL TILL	5	CR	.01 TO .10	1	.00778	.00397	.124
	GLACIAL TILL	5	CR	.10 TO 1.0	7	.0231	.0163	.0415
	GLACIAL TILL	6	CR	.001 TO .01	4	.00150	.000974	.00356
	GLACIAL TILL	6	CR	.01 TO .10	1	0	0	0
	GLACIAL TILL	4	CU	.01 TO .10	3	.00163	.00101	.00477
	GLACIAL TILL	5	CU	.01 TO .10	1	.00354	.00180	.0564
	GLACIAL TILL	5	CU	.10 TO 1.0	8	.0287	.0206	.0490
	GLACIAL TILL	6	CU	.001 TO .01	3	.00153	.000946	.00446
	GLACIAL TILL	6	CU	.01 TO .10	1	.00495	.00253	.0789
	GLACIAL TILL	4	FE	.10 TO 1.0	3	.127	.0789	.372
	GLACIAL TILL	5	FE	.01 TO .10	5	.0127	.00852	.0265
	GLACIAL TILL	5	FE	.10 TO 1.0	3	.0147	.00913	.0430
	GLACIAL TILL	6	FE	.01 TO .10	2	.0153	.00884	.0675
	GLACIAL TILL	6	FE	.10 TO 1.0	3	.0764	.0473	.223
	GLACIAL TILL	4	K	10.0 TO 100.0	3	1.30	.808	3.81
	GLACIAL TILL	5	K	10.0 TO 100.0	9	1.63	1.19	2.69
	GLACIAL TILL	6	K	1.0 TO 10.0	4	.124	.0803	.294
	GLACIAL TILL	6	K	10.0 TO 100.0	1	.0141	.00722	.226

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	GLACIAL TILL	4	LI	.01 TO .10	3	.00829	.00513	.0242
	GLACIAL TILL	5	LI	.10 TO 1.0	5	.00454	.00305	.00948
	GLACIAL TILL	6	LI	.001 TO .01	2	.00304	.00176	.0134
	GLACIAL TILL	6	LI	.01 TO .10	3	.00183	.00113	.00533
	GLACIAL TILL	5	MG	.01 TO .10	3	.00822	.00509	.0240
	GLACIAL TILL	5	MG	1.0 TO 10.0	4	.298	.193	.707
	GLACIAL TILL	6	MG	1.0 TO 10.0	1	.00707	.00361	.113
	GLACIAL TILL	6	MG	10.0 TO 100.0	4	.349	.227	.828
	GLACIAL TILL	4	MN	.001 TO .01	3	.000816	.000506	.00238
	GLACIAL TILL	5	MN	.01 TO .10	8	.00357	.00256	.00611
	GLACIAL TILL	6	MN	.001 TO .01	1	.00636	.00325	.101
	GLACIAL TILL	6	MN	.01 TO .10	4	.00137	.000889	.00325
	GLACIAL TILL	4	MO	.10 TO 1.0	3	.0154	.00955	.0450
	GLACIAL TILL	5	MO	.10 TO 1.0	9	.00940	.00686	.0155
	GLACIAL TILL	6	MO	.01 TO .10	2	.00112	.000646	.00494
	GLACIAL TILL	6	MO	.10 TO 1.0	3	.00679	.00421	.0198
	GLACIAL TILL	4	NA	10.0 TO 100.0	3	1.94	1.20	5.67
	GLACIAL TILL	5	NA	10.0 TO 100.0	9	.554	.404	.911
	GLACIAL TILL	6	NA	10.0 TO 100.0	5	.274	.184	.573
	GLACIAL TILL	5	NI	.01 TO .10	1	.00919	.00469	.147
	GLACIAL TILL	5	NI	.10 TO 1.0	7	.0194	.0137	.0348
	GLACIAL TILL	6	NI	.01 TO .10	4	.00837	.00544	.0199
	GLACIAL TILL	4	SI	1.0 TO 10.0	3	.382	.237	1.12
	GLACIAL TILL	5	SI	.10 TO 1.0	9	.0701	.0511	.115
	GLACIAL TILL	6	SI	1.0 TO 10.0	5	.0936	.0629	.196
	GLACIAL TILL	4	SR	10.0 TO 100.0	3	.209	.129	.610
	GLACIAL TILL	5	SR	10.0 TO 100.0	9	.999	.728	1.64
	GLACIAL TILL	6	SR	.10 TO 1.0	3	.00349	.00216	.0102
	GLACIAL TILL	6	SR	1.0 TO 10.0	2	.0127	.00735	.0562
	GLACIAL TILL	4	TI	.01 TO .10	3	.00943	.00584	.0275
	GLACIAL TILL	5	TI	.01 TO .10	1	.00354	.00180	.0564
	GLACIAL TILL	5	TI	.10 TO 1.0	8	.0662	.0476	.113
	GLACIAL TILL	6	TI	.001 TO .01	1	.00141	.000722	.0226
	GLACIAL TILL	6	TI	.01 TO .10	3	.00500	.00310	.0146

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	GLACIAL TILL	4	V	.01 TO .10	3	.0113	.00699	.0329
	GLACIAL TILL	5	V	.01 TO .10	1	.00707	.00361	.113
	GLACIAL TILL	5	V	.10 TO 1.0	8	.0483	.0347	.0827
	GLACIAL TILL	6	V	.001 TO .01	1	.00424	.00216	.0677
	GLACIAL TILL	6	V	.01 TO .10	2	.00930	.00537	.0411
	GLACIAL TILL	5	ZN	.01 TO .10	8	.00733	.00527	.0125
	GLACIAL TILL	6	ZN	.001 TO .01	2	.00200	.00116	.00883
	GLACIAL TILL	6	ZN	.01 TO .10	3	.000408	.000253	.00119
	ALLUVIUM	4	AL	.10 TO 1.0	3	.0727	.0450	.212
	ALLUVIUM	5	AL	.10 TO 1.0	3	.0672	.0416	.196
	ALLUVIUM	5	AL	1.0 TO 10.0	6	.312	.216	.598
	ALLUVIUM	6	AL	.10 TO 1.0	3	.0400	.0248	.117
	ALLUVIUM	6	AL	1.0 TO 10.0	1	.0636	.0325	1.01
	ALLUVIUM	4	B	.10 TO 1.0	3	.111	.0690	.325
	ALLUVIUM	5	B	.10 TO 1.0	1	.158	.0808	2.53
	ALLUVIUM	5	B	1.0 TO 10.0	8	.878	.631	1.50
	ALLUVIUM	6	B	.01 TO .10	1	.0566	.0289	.902
	ALLUVIUM	6	B	.10 TO 1.0	1	.0750	.0382	1.20
	ALLUVIUM	4	BA	.10 TO 1.0	3	.0144	.00893	.0421
	ALLUVIUM	5	BA	.01 TO .10	2	.0275	.0159	.122
	ALLUVIUM	5	BA	.10 TO 1.0	7	.0236	.0167	.0425
	ALLUVIUM	6	BA	.01 TO .10	2	.00763	.00441	.0337
	ALLUVIUM	6	BA	.10 TO 1.0	3	.0245	.0152	.0715
	ALLUVIUM	5	BE	.001 TO .01	3	.000408	.000253	.00119
	ALLUVIUM	5	BE	.01 TO .10	1	.00283	.00144	.0451
	ALLUVIUM	4	CA	100 TO 1000	3	26.2	16.2	76.5
	ALLUVIUM	5	CA	100 TO 1000	5	78.5	52.7	164
	ALLUVIUM	5	CA	1000 TO 10000	4	16.3	10.6	38.7
	ALLUVIUM	6	CA	100 TO 1000	5	2.86	1.92	5.98
	ALLUVIUM	5	CD	.01 TO .10	8	.0110	.00794	.0189
	ALLUVIUM	5	CD	.01 TO .10	3	.00277	.00172	.00809
	ALLUVIUM	5	CD	.10 TO 1.0	5	.0270	.0181	.0564
	ALLUVIUM	6	CD	.01 TO .10	1	.000707	.000361	.0113
	ALLUVIUM	4	CR	.01 TO .10	3	.00206	.00128	.00602

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	ALLUVIUM	5	CR	.01 TO .10	2	.00721	.00417	.0318
	ALLUVIUM	5	CR	.10 TO 1.0	7	.0301	.0213	.0542
	ALLUVIUM	6	CR	.001 TO .01	2	.00412	.00238	.0182
	ALLUVIUM	6	CR	.01 TO .10	3	.00297	.00184	.00868
	ALLUVIUM	4	CU	.01 TO .10	3	.00535	.00332	.0156
	ALLUVIUM	5	CU	.01 TO .10	1	.00424	.00216	.0677
	ALLUVIUM	5	CU	.10 TO 1.0	8	.0376	.0270	.0643
	ALLUVIUM	6	CU	.001 TO .01	1	.00354	.00180	.0564
	ALLUVIUM	6	CU	.01 TO .10	1	.000707	.000361	.0113
	ALLUVIUM	4	FE	.10 TO 1.0	3	.0804	.0498	.235
	ALLUVIUM	5	FE	.01 TO .10	2	.0277	.0160	.122
	ALLUVIUM	5	FE	.10 TO 1.0	7	.0608	.0429	.109
	ALLUVIUM	6	FE	.01 TO .10	3	.0255	.0158	.0744
	ALLUVIUM	6	FE	.10 TO 1.0	2	.145	.0839	.641
	ALLUVIUM	4	K	10.0 TO 100.0	3	1.75	1.09	5.12
	ALLUVIUM	5	K	10.0 TO 100.0	9	2.15	1.57	3.53
	ALLUVIUM	6	K	10.0 TO 100.0	5	.275	.185	.574
	ALLUVIUM	4	LI	.01 TO .10	3	.00602	.00373	.0176
	ALLUVIUM	5	LI	.01 TO .10	1	.00283	.00144	.0451
	ALLUVIUM	5	LI	.10 TO 1.0	4	.0166	.0107	.0393
	ALLUVIUM	6	LI	.001 TO .01	2	.00200	.00116	.00883
	ALLUVIUM	5	MG	.01 TO .10	4	.00150	.000974	.00356
	ALLUVIUM	5	MG	1.0 TO 10.0	4	.324	.211	.769
	ALLUVIUM	5	MG	10.0 TO 100.0	1	.297	.152	4.74
	ALLUVIUM	6	MG	.01 TO .10	1	.00778	.00397	.124
	ALLUVIUM	6	MG	1.0 TO 10.0	1	.577	.294	9.20
	ALLUVIUM	6	MG	10.0 TO 100.0	3	.142	.0880	.415
	ALLUVIUM	4	MN	.001 TO .01	3	.00320	.00198	.00935
	ALLUVIUM	5	MN	.001 TO .01	1	.00141	.000722	.0226
	ALLUVIUM	5	MN	.01 TO .10	8	.00457	.00328	.00782
	ALLUVIUM	6	MN	.001 TO .01	1	0	0	0
	ALLUVIUM	6	MN	.01 TO .10	1	.0403	.0206	.643
	ALLUVIUM	6	MN	.10 TO 1.0	1	.0156	.00794	.248
	ALLUVIUM	6	MN	1.0 TO 10.0	2	.0396	.0229	.175

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	ALLUVIUM	4	MO	.10 TO 1.0	3	.0101	.00626	.0295
	ALLUVIUM	5	MO	.10 TO 1.0	9	.0248	.0181	.0408
	ALLUVIUM	6	MO	.01 TO .10	1	.0417	.0213	.665
	ALLUVIUM	6	MO	.10 TO 1.0	1	0	0	0
	ALLUVIUM	4	NA	10.0 TO 100.0	3	.814	.505	2.38
	ALLUVIUM	5	NA	10.0 TO 100.0	9	.813	.593	1.34
	ALLUVIUM	6	NA	10.0 TO 100.0	5	.138	.0929	.289
	ALLUVIUM	5	NI	.01 TO .10	1	.00636	.00325	.101
	ALLUVIUM	5	NI	.10 TO 1.0	7	.0252	.0178	.0453
	ALLUVIUM	6	NI	.01 TO .10	5	.00138	.000926	.00288
	ALLUVIUM	4	SI	1.0 TO 10.0	3	.165	.102	.480
	ALLUVIUM	5	SI	.10 TO 1.0	9	.183	.133	.301
	ALLUVIUM	6	SI	1.0 TO 10.0	3	.409	.253	1.19
	ALLUVIUM	6	SI	10.0 TO 100.0	2	.172	.0996	.761
	ALLUVIUM	4	SR	10.0 TO 100.0	3	.0793	.0491	.232
	ALLUVIUM	5	SR	10.0 TO 100.0	9	1.33	.968	2.18
	ALLUVIUM	6	SR	1.0 TO 10.0	5	.0318	.0214	.0664
	ALLUVIUM	4	TI	.01 TO .10	3	.00938	.00581	.0274
	ALLUVIUM	5	TI	.01 TO .10	1	.0148	.00758	.237
	ALLUVIUM	5	TI	.10 TO 1.0	8	.0829	.0596	.142
	ALLUVIUM	6	TI	.01 TO .10	3	.00582	.00360	.0170
	ALLUVIUM	4	V	.01 TO .10	3	.0143	.00884	.0417
	ALLUVIUM	5	V	.01 TO .10	1	.00707	.00361	.113
	ALLUVIUM	5	V	.10 TO 1.0	8	.0639	.0459	.109
	ALLUVIUM	6	V	.001 TO .01	1	.00707	.00361	.113
	ALLUVIUM	6	V	.01 TO .10	1	.000707	.000361	.0113
	ALLUVIUM	5	ZN	.01 TO .10	8	.00953	.00684	.0163
	ALLUVIUM	6	ZN	.01 TO .10	2	.00100	.000578	.00442
	LIMESTONE	4	AL	.10 TO 1.0	3	.0363	.0225	.106
	LIMESTONE	5	AL	.10 TO 1.0	1	.00424	.00216	.0677
	LIMESTONE	5	AL	1.0 TO 10.0	8	.347	.249	.594
	LIMESTONE	6	AL	.10 TO 1.0	5	.0391	.0263	.0818
	LIMESTONE	5	B	.10 TO 1.0	1	.112	.0570	1.78
	LIMESTONE	5	B	1.0 TO 10.0	8	1.15	.829	1.97

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	LIMESTONE	6	B	.01 TO .10	3	.0462	.0286	.135
	LIMESTONE	6	B	.10 TO 1.0	1	.0601	.0307	.958
	LIMESTONE	4	BA	.01 TO .10	3	.0103	.00641	.0302
	LIMESTONE	5	BA	.01 TO .10	8	.0136	.00977	.0233
	LIMESTONE	5	BA	.10 TO 1.0	1	.0460	.0235	.733
	LIMESTONE	6	BA	.01 TO .10	5	.0130	.00875	.0272
	LIMESTONE	5	BE	.001 TO .01	4	.00122	.000795	.00291
	LIMESTONE	4	CA	100 TO 1000	3	58.9	36.5	172
	LIMESTONE	5	CA	.10 TO 1.0	1	.00445	.00227	.0710
	LIMESTONE	5	CA	100 TO 1000	2	75.6	43.7	334
	LIMESTONE	5	CA	1000 TO 10000	6	44.7	30.8	85.6
	LIMESTONE	6	CA	10.0 TO 100.0	2	.633	.366	2.79
	LIMESTONE	6	CA	100 TO 1000	3	1.69	1.05	4.93
	LIMESTONE	5	CD	.01 TO .10	8	.0140	.0100	.0239
	LIMESTONE	6	CD	.01 TO .10	3	.0159	.00984	.0464
	LIMESTONE	5	CD	.10 TO 1.0	6	.0280	.0193	.0536
	LIMESTONE	5	CR	.01 TO .10	1	.00990	.00505	.158
	LIMESTONE	5	CR	.10 TO 1.0	8	.0356	.0256	.0609
	LIMESTONE	6	CR	.001 TO .01	2	.00150	.000867	.00662
	LIMESTONE	4	CU	.01 TO .10	3	.00804	.00498	.0235
	LIMESTONE	5	CU	.01 TO .10	1	.00283	.00144	.0451
	LIMESTONE	5	CU	.10 TO 1.0	8	.0483	.0347	.0826
	LIMESTONE	5	FE	.01 TO .10	7	.0181	.0128	.0326
	LIMESTONE	5	FE	.10 TO 1.0	1	.0170	.00866	.271
	LIMESTONE	6	FE	.01 TO .10	2	.0226	.0131	.0997
	LIMESTONE	4	K	10.0 TO 100.0	3	1.16	.719	3.39
	LIMESTONE	5	K	10.0 TO 100.0	9	1.32	.965	2.18
	LIMESTONE	6	K	10.0 TO 100.0	1	2.82	1.44	45.0
	LIMESTONE	6	K	100 TO 1000	4	1.20	.777	2.84
	LIMESTONE	4	LI	.10 TO 1.0	3	.0271	.0168	.0792
	LIMESTONE	5	LI	.10 TO 1.0	5	.0119	.00801	.0249
	LIMESTONE	6	LI	.01 TO .10	5	.000775	.000521	.00162
	LIMESTONE	4	MG	100 TO 1000	3	335	208	979
	LIMESTONE	5	MG	.01 TO .10	3	.0152	.00940	.0443

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	LIMESTONE	5	MG	1.0 TO 10.0	4	.461	.299	1.09
	LIMESTONE	6	MG	.01 TO .10	1	.0156	.00794	.248
	LIMESTONE	6	MG	1.0 TO 10.0	1	.0255	.0130	.406
	LIMESTONE	6	MG	10.0 TO 100.0	3	.156	.0967	.456
	LIMESTONE	5	MN	.001 TO .01	1	.000707	.000361	.0113
	LIMESTONE	5	MN	.01 TO .10	8	.00568	.00408	.00973
	LIMESTONE	6	MN	.001 TO .01	4	.000354	.000230	.000839
	LIMESTONE	4	MO	.10 TO 1.0	3	.0258	.0160	.0753
	LIMESTONE	5	MO	.10 TO 1.0	9	.0184	.0134	.0303
	LIMESTONE	6	MO	.10 TO 1.0	3	.00819	.00507	.0239
	LIMESTONE	6	MO	1.0 TO 10.0	2	.00875	.00505	.0386
	LIMESTONE	4	NA	10.0 TO 100.0	3	1.31	.809	3.81
	LIMESTONE	5	NA	10.0 TO 100.0	9	.473	.345	.778
	LIMESTONE	6	NA	10.0 TO 100.0	4	.733	.476	1.74
	LIMESTONE	6	NA	100 TO 1000	1	359	183	5730
	LIMESTONE	5	NI	.10 TO 1.0	8	.0282	.0202	.0482
	LIMESTONE	6	NI	.01 TO .10	3	.00265	.00164	.00773
	LIMESTONE	4	SI	.10 TO 1.0	3	.300	.186	.876
	LIMESTONE	5	SI	.10 TO 1.0	9	.0905	.0660	.149
	LIMESTONE	6	SI	1.0 TO 10.0	5	.208	.140	.434
	LIMESTONE	4	SR	10.0 TO 100.0	3	.374	.232	1.09
	LIMESTONE	5	SR	10.0 TO 100.0	9	1.17	.852	1.92
	LIMESTONE	6	SR	1.0 TO 10.0	3	.0394	.0244	.115
	LIMESTONE	6	SR	10.0 TO 100.0	2	.0707	.0408	.312
	LIMESTONE	4	TI	.01 TO .10	3	.0115	.00713	.0336
	LIMESTONE	5	TI	.01 TO .10	1	.00354	.00180	.0564
	LIMESTONE	5	TI	.10 TO 1.0	8	.110	.0791	.188
	LIMESTONE	4	V	.01 TO .10	3	.0214	.0133	.0625
	LIMESTONE	5	V	.01 TO .10	1	.0233	.0119	.372
	LIMESTONE	5	V	.10 TO 1.0	8	.0841	.0604	.144
	LIMESTONE	6	V	.01 TO .10	1	.00141	.000722	.0226
	LIMESTONE	5	ZN	.01 TO .10	8	.0105	.00753	.0179
	LIMESTONE	6	ZN	.001 TO .01	1	.00141	.000722	.0226

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
WET CHEMISTRY								
	SHALE	4	COND	1000 TO 10000	3	134	83.3	392
	SHALE	5	COND	1000 TO 10000	9	94.3	68.8	155
	SHALE	6	COND	1000 TO 10000	5	3830	2570	7990
	SHALE	4	C1	10.0 TO 100.0	3	2.63	1.63	7.68
	SHALE	5	C1	10.0 TO 100.0	9	1.33	.972	2.19
	SHALE	6	C1	10.0 TO 100.0	5	.316	.213	.661
	SHALE	4	F	.10 TO 1.0	3	.0327	.0202	.0954
	SHALE	5	F	.10 TO 1.0	9	.0398	.0290	.0655
	SHALE	6	F	.10 TO 1.0	5	.0307	.0206	.0641
	SHALE	4	PH	10.0 TO 100.0	3	.115	.0715	.337
	SHALE	5	PH	10.0 TO 100.0	9	.0408	.0298	.0672
	SHALE	6	PH	1.0 TO 10.0	5	.0316	.0213	.0661
	SHALE	4	SO4	100 TO 1000	3	65.8	40.8	192
	SHALE	5	SO4	100 TO 1000	9	49.4	36.0	81.3
	SHALE	6	SO4	100 TO 1000	5	14.5	9.74	30.3
	SHALE	4	TDS	1000 TO 10000	3	33.7	20.9	98.3
	SHALE	5	TDS	1000 TO 10000	9	54.6	39.8	89.9
	SHALE	6	TDS	1000 TO 10000	5	29.0	19.5	60.6
	INTERBURDEN	4	COND	1000 TO 10000	3	593	368	1730
	INTERBURDEN	5	COND	1000 TO 10000	9	55.3	40.3	90.9
	INTERBURDEN	6	COND	1000 TO 10000	5	46.2	31.0	96.4
	INTERBURDEN	4	C1	10.0 TO 100.0	3	1.00	.620	2.92
	INTERBURDEN	5	C1	10.0 TO 100.0	9	.333	.243	.548
	INTERBURDEN	6	C1	10.0 TO 100.0	5	1.64	1.10	3.43
	INTERBURDEN	4	F	1.0 TO 10.0	3	1.14	.709	3.34
	INTERBURDEN	5	F	.10 TO 1.0	9	.101	.0733	.165
	INTERBURDEN	6	F	.10 TO 1.0	4	.0998	.0648	.237
	INTERBURDEN	6	F	1.0 TO 10.0	1	0	0	0
	INTERBURDEN	4	PH	10.0 TO 100.0	3	.0577	.0358	.169
	INTERBURDEN	5	PH	10.0 TO 100.0	9	.0236	.0172	.0388
	INTERBURDEN	6	PH	1.0 TO 10.0	5	.0969	.0651	.202
	INTERBURDEN	4	SO4	100 TO 1000	3	82.4	51.1	241

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	INTERBURDEN	5	SO4	100 TO 1000	6	2.89	1.99	5.53
	INTERBURDEN	5	SO4	1000 TO 10000	3	5.77	3.58	16.9
	INTERBURDEN	6	SO4	100 TO 1000	1	0	0	0
	INTERBURDEN	6	SO4	1000 TO 10000	4	15.4	10.0	36.6
	INTERBURDEN	4	TDS	1000 TO 10000	3	18.9	11.7	55.3
	INTERBURDEN	5	TDS	1000 TO 10000	9	43.5	31.7	71.6
	INTERBURDEN	6	TDS	1000 TO 10000	5	31.3	21.0	65.4
	SANDSTONE	4	COND	1000 TO 10000	3	552	342	1610
	SANDSTONE	5	COND	1000 TO 10000	9	172	126	283
	SANDSTONE	6	COND	1000 TO 10000	5	4.47	3.01	9.34
	SANDSTONE	4	C1	10.0 TO 100.0	3	7.37	4.56	21.5
	SANDSTONE	5	C1	10.0 TO 100.0	9	.943	.688	1.55
	SANDSTONE	6	C1	10.0 TO 100.0	5	.837	.562	1.75
	SANDSTONE	4	F	.10 TO 1.0	3	.0640	.0396	.187
	SANDSTONE	5	F	.10 TO 1.0	9	.282	.206	.464
	SANDSTONE	6	F	.10 TO 1.0	5	.0866	.0582	.181
	SANDSTONE	4	PH	10.0 TO 100.0	3	.0723	.0448	.211
	SANDSTONE	5	PH	10.0 TO 100.0	9	0	0	0
	SANDSTONE	6	PH	1.0 TO 10.0	4	.0310	.0201	.0736
	SANDSTONE	6	PH	10.0 TO 100.0	1	.00707	.00361	.113
	SANDSTONE	4	SO4	100 TO 1000	3	22.2	13.7	64.7
	SANDSTONE	5	SO4	100 TO 1000	7	20.0	14.1	35.9
	SANDSTONE	5	SO4	1000 TO 10000	2	10.0	5.78	44.2
	SANDSTONE	6	SO4	100 TO 1000	3	10.8	6.70	31.6
	SANDSTONE	6	SO4	1000 TO 10000	2	40.0	23.1	177
	SANDSTONE	4	TDS	1000 TO 10000	3	425	263	1240
	SANDSTONE	5	TDS	1000 TO 10000	9	126	91.6	207
	SANDSTONE	6	TDS	1000 TO 10000	5	193	130	403
	GLACIAL TILL	4	COND	1000 TO 10000	3	142	88.1	415
	GLACIAL TILL	5	COND	1000 TO 10000	9	183	134	302
	GLACIAL TILL	6	COND	1000 TO 10000	5	0	0	0
	GLACIAL TILL	4	C1	10.0 TO 100.0	3	1.50	.929	4.38
	GLACIAL TILL	5	C1	10.0 TO 100.0	9	.707	.516	1.16
	GLACIAL TILL	6	C1	10.0 TO 100.0	5	.837	.562	1.75

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	GLACIAL TILL	4	F	.10 TO 1.0	3	.0929	.0575	.271
	GLACIAL TILL	5	F	.10 TO 1.0	9	.0467	.0341	.0769
	GLACIAL TILL	6	F	.10 TO 1.0	3	.0135	.00839	.0395
	GLACIAL TILL	6	F	1.0 TO 10.0	2	.0292	.0168	.129
	GLACIAL TILL	4	PH	10.0 TO 100.0	3	.0592	.0367	.173
	GLACIAL TILL	5	PH	10.0 TO 100.0	9	.0311	.0227	.0512
	GLACIAL TILL	6	PH	1.0 TO 10.0	5	.0396	.0266	.0828
	GLACIAL TILL	4	SO4	100 TO 1000	3	59.2	36.7	173
	GLACIAL TILL	5	SO4	100 TO 1000	8	10.6	7.62	18.1
	GLACIAL TILL	5	SO4	1000 TO 10000	1	7.07	3.61	113
	GLACIAL TILL	6	SO4	100 TO 1000	5	7.38	4.96	15.4
	GLACIAL TILL	4	TDS	1000 TO 10000	3	73.7	45.6	215
	GLACIAL TILL	5	TDS	1000 TO 10000	9	79.5	58.0	131
	GLACIAL TILL	6	TDS	1000 TO 10000	4	155	101	367
	ALLUVIUM	4	COND	1000 TO 10000	3	118	73.2	345
	ALLUVIUM	5	COND	1000 TO 10000	9	54.0	39.4	88.9
	ALLUVIUM	6	COND	1000 TO 10000	5	33.0	22.2	69.0
	ALLUVIUM	4	Cl	10.0 TO 100.0	3	.577	.358	1.69
	ALLUVIUM	5	Cl	10.0 TO 100.0	9	.667	.486	1.10
	ALLUVIUM	6	Cl	10.0 TO 100.0	5	4.15	2.79	8.66
	ALLUVIUM	4	F	.10 TO 1.0	3	.893	.553	2.61
	ALLUVIUM	5	F	.01 TO .10	1	.0141	.00722	.226
	ALLUVIUM	5	F	.10 TO 1.0	8	.0300	.0215	.0513
	ALLUVIUM	6	F	.01 TO .10	1	.0566	.0289	.902
	ALLUVIUM	6	F	.10 TO 1.0	4	.0366	.0237	.0868
	ALLUVIUM	4	PH	10.0 TO 100.0	3	.0465	.0288	.136
	ALLUVIUM	5	PH	10.0 TO 100.0	9	0	0	0
	ALLUVIUM	6	PH	1.0 TO 10.0	4	.158	.102	.374
	ALLUVIUM	6	PH	10.0 TO 100.0	1	.0495	.0253	.789
	ALLUVIUM	4	SO4	100 TO 1000	3	23.2	14.4	67.8
	ALLUVIUM	5	SO4	100 TO 1000	5	7.07	4.75	14.8
	ALLUVIUM	5	SO4	1000 TO 10000	4	8.66	5.62	20.5
	ALLUVIUM	6	SO4	100 TO 1000	5	18.7	12.6	39.1
	ALLUVIUM	4	TDS	1000 TO 10000	3	75.9	47.0	222

TABLE H-15. (Continued)

METHOD OF ANALYSIS	DISPOSAL MEDIUM	PROTOCOL STEP	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
							LOWER	UPPER
	ALLUVIUM	5	TDS	1000 TO 10000	9	40.8	29.7	67.1
	ALLUVIUM	6	TDS	100 TO 1000	1	61.5	31.4	981
	ALLUVIUM	6	TDS	1000 TO 10000	4	146	94.9	347
	LIMESTONE	4	COND	1000 TO 10000	3	494	306	1440
	LIMESTONE	5	COND	1000 TO 10000	9	202	148	333
	LIMESTONE	6	COND	1000 TO 10000	5	36.1	24.3	75.4
	LIMESTONE	4	Cl	10.0 TO 100.0	3	1.15	.715	3.37
	LIMESTONE	5	Cl	10.0 TO 100.0	9	1.00	.729	1.65
	LIMESTONE	6	Cl	10.0 TO 100.0	5	.548	.368	1.14
	LIMESTONE	4	F	.10 TO 1.0	3	.0408	.0253	.119
	LIMESTONE	5	F	.10 TO 1.0	9	.0893	.0651	.147
	LIMESTONE	6	F	.10 TO 1.0	2	.0316	.0183	.140
	LIMESTONE	6	F	1.0 TO 10.0	3	.119	.0735	.347
	LIMESTONE	4	PH	10.0 TO 100.0	3	.0753	.0466	.220
	LIMESTONE	5	PH	10.0 TO 100.0	9	.0236	.0172	.0388
	LIMESTONE	6	PH	1.0 TO 10.0	4	.0636	.0413	.151
	LIMESTONE	6	PH	10.0 TO 100.0	1	.0354	.0180	.564
	LIMESTONE	4	SO4	100 TO 1000	3	3.95	2.45	11.5
	LIMESTONE	5	SO4	1000 TO 10000	9	6.24	4.55	10.3
	LIMESTONE	6	SO4	100 TO 1000	5	7.54	5.06	15.7
	LIMESTONE	4	TDS	1000 TO 10000	3	397	246	1160
	LIMESTONE	5	TDS	1000 TO 10000	9	42.3	30.8	69.6
	LIMESTONE	6	TDS	100 TO 1000	5	104	69.7	217

Appendix H

Attachment 5

Table H-16

Preceding page blank

Preceding page blank

TABLE H-16. UNCERTAINTIES FOR FIELD DATA: UPPER SAMPLING POINT FOR FIELD CELLS 1 AND 2 (EXXON PFBC WASTE AND SHALE)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
ICPES						
	AG	.001 TO .01	3	.00488	.00302	.0142
	AG	.01 TO .10	10	.0217	.0161	.0346
	AS	.10 TO 1.0	2	.0367	.0212	.162
	AL	.01 TO .10	2	.0151	.00874	.0668
	AL	.10 TO 1.0	15	.244	.189	.351
	AL	1.0 TO 10.0	4	.589	.383	1.40
	B	1.0 TO 10.0	20	1.41	1.12	1.91
	P	10.0 TO 100.0	4	2.86	1.86	6.78
	PA	.01 TO .10	9	.0154	.0112	.0253
	BA	.10 TO 1.0	11	.0368	.0275	.0571
	BE	.001 TO .01	1	.00283	.00144	.0451
	CA	100 TO 1000	23	77.0	62.3	102
	CA	1000 TO 10000	1	110	55.9	1750
	CD	.01 TO .10	2	.0235	.0136	.104
	CD	.10 TO 1.0	1	.0344	.0176	.549
	CO	.01 TO .10	4	.0416	.0270	.0986
	CO	.10 TO 1.0	6	.0636	.0439	.122
	CR	.01 TO .10	19	.0152	.0121	.0208
	CR	.10 TO 1.0	2	.0971	.0561	.429
	CU	.001 TO .01	1	.00167	.000853	.0267
	CU	.01 TO .10	6	.0213	.0147	.0407
	FE	.01 TO .10	15	.0198	.0153	.0284
	FE	.10 TO 1.0	4	.0563	.0365	.134
	K	100 TO 1000	12	184	139	278
	K	1000 TO 10000	6	383	264	734
	LI	.10 TO 1.0	6	.123	.0848	.235
	MG	1.0 TO 10.0	3	5.82	3.60	17.0
	MG	10.0 TO 100.0	8	19.7	14.2	33.8

TABLE H-16. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	MG	100 TO 1000	13	62.2	47.4	92.4
	MN	.01 TO .10	1	.0643	.0328	1.03
	MN	.10 TO 1.0	4	.249	.161	.590
	MN	1.0 TO 10.0	13	3.97	3.03	5.90
	MN	10.0 TO 100.0	2	24.9	14.4	110
	MO	.01 TO .10	1	.0544	.0278	.868
	MO	.10 TO 1.0	19	.0686	.0545	.0940
	NA	10.0 TO 100.0	14	19.4	14.9	28.3
	NA	100 TO 1000	9	226	165	372
	NI	.01 TO .10	5	.0239	.0160	.0499
	NI	.10 TO 1.0	14	.0571	.0439	.0833
	SI	10.0 TO 100.0	24	9.02	7.32	11.9
	SR	.10 TO 1.0	8	.185	.133	.316
	SR	1.0 TO 10.0	16	.306	.238	.433
	TI	.001 TO .01	2	.00294	.00170	.0130
	TI	.01 TO .10	11	.00405	.00303	.00628
	TI	.10 TO 1.0	4	.123	.0795	.291
	V	.01 TO .10	3	.0366	.0227	.107
	V	.10 TO 1.0	18	.0657	.0519	.0910
	ZN	.01 TO .10	14	.0401	.0308	.0585
	ZN	.10 TO 1.0	9	.216	.157	.355
AA						
	LI	1.0 TO 10.0	11	1.03	.771	1.60
WET CHEMISTRY						
	COND	1000 TO 10000	15	1530	1180	2190
	COND	10000 TO 100000	8	2820	2030	4830
	CL	1.0 TO 10.0	1	6.22	3.17	99.2
	CL	10.0 TO 100.0	7	16.6	11.7	29.9

TABLE H-16. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALLES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	Cl	100 TO 1000	4	58.8	38.2	139
	F	.10 TO 1.0	23	.0584	.0472	.0774
	PH	1.0 TO 10.0	23	.212	.172	.281
	SO4	1000 TO 30000	23	1270	1030	1690
	TDS	1000 TO 10000	16	1680	1310	2390
	TDS	10000 TO 100000	7	2990	2110	5370
	TOC	1.0 TO 10.0	3	2.72	1.68	7.93
	TOC	10.0 TO 100.0	9	3.33	2.43	5.47

Appendix H

Attachment 6

Table H-17

Preceding page blank

TABLE H-17. UNCERTAINTIES FOR FIELD DATA: LOWER SAMPLING POINT FOR FIELD CELLS 1 AND 2 (EXXON PFBC WASTE AND SHALE)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
ICPES						
	AG	.001 TO .01	1	.00127	.000649	.0203
	AG	.01 TO .10	7	.0138	.00972	.0248
	AG	.10 TO 1.0	2	.0445	.0257	.196
	AL	.01 TO .10	1	.0174	.00867	.277
	AL	.10 TO 1.0	9	.0548	.0400	.0902
	AL	1.0 TO 10.0	12	.151	.114	.229
	B	.10 TO 1.0	7	.737	.520	1.32
	B	1.0 TO 10.0	18	.703	.555	.974
	BA	.001 TO .01	2	.00127	.000735	.00562
	BA	.01 TO .10	3	.0101	.00628	.0296
	BA	.10 TO 1.0	12	.0606	.0458	.0918
	BE	.001 TO .01	1	.00141	.000722	.0226
	CA	100 TO 1000	23	84.0	67.9	111
	CA	1000 TO 10000	2	186	107	819
	CD	.01 TO .10	3	.0168	.0104	.0492
	CD	.10 TO 1.0	1	.000707	.000361	.0113
	CO	.01 TO .10	4	.0174	.0113	.0413
	CO	.10 TO 1.0	6	.0850	.0587	.163
	CR	.01 TO .10	17	.00444	.00349	.00622
	CR	.10 TO 1.0	5	.0434	.0292	.0908
	CU	.01 TO .10	8	.00405	.00291	.00693
	CU	.10 TO 1.0	1	.00707	.00361	.113
	FE	.01 TO .10	18	.00691	.00546	.00957
	FE	.10 TO 1.0	2	.0830	.0479	.366
	K	100 TO 3000	19	111	87.7	151
	LI	.01 TO .10	2	.0588	.0340	.260
	LI	.10 TO 1.0	4	.0405	.0263	.0961
	MG	.01 TO .10	1	.0163	.00830	.259

TABLE H-17. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	MG	10.0 TO 100.0	3	1.01	.628	2.96
	MG	100 TO 1000	21	27.1	21.7	36.5
	MN	.001 TO .01	1	.000707	.000361	.0113
	MN	.01 TO .10	5	.0358	.0241	.0748
	MN	.10 TO 1.0	9	.139	.101	.228
	MN	1.0 TO 10.0	6	.192	.133	.368
	MO	.01 TO .10	7	.0105	.00743	.0189
	MO	.10 TO 1.0	7	.0571	.0403	.103
	NA	10.0 TO 100.0	9	7.88	5.75	13.0
	NA	100 TO 1000	16	77.3	60.3	110
	NI	.01 TO .10	6	.0108	.00742	.0206
	NI	.10 TO 1.0	14	.0197	.0151	.0287
	SI	1.0 TO 10.0	6	2.95	2.04	5.66
	SI	10.0 TO 100.0	19	2.75	2.19	3.78
	SR	1.0 TO 10.0	25	.101	.0826	.133
	TI	.01 TO .10	12	.00371	.00280	.00562
	TI	.10 TO 1.0	5	.105	.0704	.219
	V	.01 TO .10	3	.00873	.00541	.0255
	V	.10 TO 1.0	18	.0340	.0268	.0470
	ZN	.01 TO .10	15	.0134	.0104	.0193
	ZN	.10 TO 1.0	9	.133	.0971	.219
AA						
	LI	.10 TO 1.0	11	.261	.195	.404
WET CHEMISTRY						
	COND	1000 TO 10000	25	833	679	1090
	Cl	1.0 TO 10.0	1	3.39	1.73	54.1
	Cl	10.0 TO 100.0	7	40.4	28.5	72.6
	Cl	100 TO 1000	5	9.91	6.66	20.7

TABLE H-17. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	F	.10 TO 1.0	25	.0327	.0266	.0427
	PH	1.0 TO 30.0	25	.131	.107	.172
	SO4	1000 TO 10000	25	416	339	544
	TDS	1000 TO 10000	25	626	510	819
	TOC	1.0 TO 30.0	7	2.51	1.77	4.51
	TOC	10.0 TO 100.0	9	3.52	2.57	5.79

Appendix H

Attachment 7

Table H-18

Preceding page blank

Preceding page blank

TABLE H-18. UNCERTAINTIES FOR FIELD DATA: UPPER SAMPLING POINT FOR FIELD CELLS 14 AND 15 (ALLIANCE AFBC WASTE AND ALLUVIUM)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
ICPES						
	AL	.10 TO 1.0	3	.385	.239	1.13
	AL	1.0 TO 10.0	3	.449	.278	1.31
	B	.10 TO 1.0	2	.354	.205	1.56
	P	1.0 TO 10.0	4	.704	.457	1.67
	PA	.01 TO .10	1	.0127	.00649	.203
	BA	.10 TO 1.0	6	.143	.0989	.274
	CA	.10 TO 1.0	2	.0232	.0134	.102
	CA	100 TO 1000	6	380	262	727
	CR	.01 TO .10	3	.0249	.0154	.0726
	CR	.10 TO 1.0	3	.0602	.0373	.176
	CU	.001 TO .01	1	.00212	.00108	.0338
	CU	.01 TO .10	4	.0482	.0313	.114
	FE	.10 TO 1.0	4	.604	.392	1.43
	FE	1.0 TO 10.0	2	2.10	1.21	9.26
	K	100 TO 1000	8	235	169	403
	LI	1.0 TO 10.0	7	1.06	.745	1.90
	MG	1.0 TO 10.0	2	2.92	1.69	12.9
	MG	10.0 TO 100.0	1	32.3	16.5	515
	MN	.001 TO .01	1	.00212	.00108	.0338
	MN	.01 TO .10	1	.00849	.00433	.135
	MN	.10 TO 1.0	5	.457	.307	.955
	MO	.10 TO 1.0	3	.164	.101	.478
	MO	1.0 TO 10.0	3	.0913	.0566	.267
	NA	10.0 TO 100.0	1	88.4	45.1	1410
	NA	100 TO 1000	7	100	70.8	180
	NI	.01 TO .10	2	.0245	.0142	.108
	SI	1.0 TO 10.0	3	9.97	6.18	29.1
	SI	10.0 TO 100.0	5	24.0	16.1	50.1

TABLE H-18. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	SR	1.0 TO 10.0	2	6.45	3.73	28.5
	SR	10.0 TO 100.0	6	13.2	9.08	25.2
	TI	.01 TO .10	1	.0290	.0148	.462
	TI	.10 TO 1.0	2	.162	.0938	.717
	V	.01 TO .10	1	.0184	.00938	.293
	V	.10 TO 1.0	2	.182	.105	.805
	ZN	.01 TO .10	2	.0393	.0227	.173
AA						
	MG	1.0 TO 10.0	3	0	0	0
WET CHEMISTRY						
	COND	1000 TO 10000	7	1120	793	2020
	Cl	100 TO 1000	5	438	294	914
	Cl	1000 TO 10000	2	1360	784	5990
	F	.10 TO 1.0	7	.0785	.0554	.141
	PH	1.0 TO 10.0	4	2.51	1.63	5.96
	PH	10.0 TO 100.0	3	2.77	1.72	8.09
	SO4	100 TO 1000	1	113	57.7	1800
	SO4	1000 TO 10000	6	347	240	665
	TDS	1000 TO 10000	7	1100	779	1980
	TOC	10.0 TO 100.0	1	2.33	1.19	37.2

Appendix H

Attachment 8

Table H-19

Preceding page blank

TABLE H-19. UNCERTAINTIES FOR FIELD DATA: LOWER SAMPLING POINT FOR FIELD CELLS 14 AND 15 (ALLIANCE AFBC WASTE AND ALLUVIUM)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
ICPES						
	AL	.10 TO 1.0	7	.401	.283	.721
	AL	1.0 TO 10.0	7	.389	.274	.699
	AL	10.0 TO 100.0	1	10.6	5.41	169
	B	.10 TO 1.0	5	.237	.159	.494
	B	1.0 TO 10.0	5	.490	.329	1.02
	B	100 TO 1000	1	12.7	6.49	203
	BA	.10 TO 1.0	12	.400	.302	.606
	BA	1.0 TO 10.0	3	.280	.174	.818
	BE	.001 TO .01	1	.00212	.00108	.0338
	CA	10.0 TO 100.0	2	63.9	36.9	282
	CA	100 TO 1000	14	83.6	64.3	122
	CO	.01 TO .10	1	.0636	.0325	1.01
	CR	.001 TO .01	4	.00294	.00191	.00697
	CR	.01 TO .10	2	.0255	.0147	.113
	CR	.10 TO 1.0	2	.0697	.0403	.308
	CU	.001 TO .01	2	.00354	.00204	.0156
	CU	.01 TO .10	4	.0168	.0109	.0398
	CU	.10 TO 1.0	1	.0933	.0476	1.49
	FE	.01 TO .10	2	.0509	.0294	.225
	FE	.10 TO 1.0	10	.352	.260	.560
	FE	1.0 TO 10.0	1	1.33	.677	21.2
	K	1.0 TO 10.0	9	1.88	1.37	3.09
	K	10.0 TO 100.0	7	4.56	3.22	8.20
	LI	.001 TO .01	3	.00438	.00271	.0128
	LI	.01 TO .10	2	.0662	.0382	.292
	MG	.10 TO 1.0	1	.349	.178	5.57
	MG	1.0 TO 10.0	2	.302	.175	1.34
	MG	10.0 TO 100.0	10	11.5	8.52	18.4

TABLE H-19. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	MN	.10 TO 1.0	9	.187	.137	.308
	MN	1.0 TO 10.0	4	.226	.147	.537
	MO	.01 TO .10	6	.0339	.0234	.0649
	NA	10.0 TO 100.0	15	29.3	22.7	42.2
	NA	100 TO 1000	1	51.6	26.3	823
	NI	.01 TO .10	8	.0292	.0210	.0499
	NI	.10 TO 1.0	2	.0945	.0546	.417
	SI	1.0 TO 10.0	8	.568	.408	.972
	SI	10.0 TO 100.0	8	1.20	.860	2.05
	SR	.10 TO 1.0	10	.243	.179	.387
	SR	1.0 TO 10.0	6	.870	.600	1.67
	TI	.01 TO .10	1	.0629	.0321	1.00
	TI	.10 TO 1.0	1	.266	.136	4.24
	V	.01 TO .10	3	.0293	.0182	.0856
	V	.10 TO 1.0	1	.182	.0931	2.91
	ZN	.01 TO .10	9	.0148	.0108	.0244
	ZN	.10 TO 1.0	7	.0447	.0316	.0804
AA						
	MG	10.0 TO 100.0	3	22.4	13.9	65.5
WET CHEMISTRY						
	COND	100 TO 1000	3	609	378	1780
	COND	1000 TO 10000	14	424	326	620
	CL	100 TO 1000	17	169	133	237
	F	.01 TO .10	6	.0299	.0206	.0572
	F	.10 TO 1.0	11	.145	.109	.225
	PH	1.0 TO 10.0	17	.587	.461	.822
	SO4	10.0 TO 100.0	7	29.2	20.6	52.5
	SO4	100 TO 1000	10	245	181	390

TABLE H-19. (Continued)

METHOD OF ANALYSIS	PARAMETER	RANGE OF VALUES	NO. OF DEGREES OF FREEDOM	STANDARD ERROR	90% CONFIDENCE LIMITS FOR STANDARD ERROR	
					LOWER	UPPER
	TDS	100 TO 1000	3	705	437	2060
	TDS	1000 TO 10000	14	396	305	579
	TOC	1.0 TO 10.0	3	4.94	3.06	14.4